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FINAL PRELIMINARY ASSESSMENT/SITE INSPECTION REPORT SITE UXO 25 VERONA LOOP MCB CAMP LEJEUNE NC

2/1/2013

CH2MHILL

Final

Preliminary Assessment/Site Inspection Report
Site UXO-25 – Verona Loop

Marine Corps Installations East –
Marine Corps Base Camp Lejeune
Jacksonville, North Carolina

Contract Task Order WE18

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Prepared by

CH2MHILL

11301 Carmel Commons Blvd., Suite 304
Charlotte, North Carolina 28226
NC Engineering License #F-0699

Executive Summary

A Preliminary Assessment/Site Inspection (PA/SI) was conducted at Site Unexploded Ordnance (UXO)-25 – Verona Loop, Marine Corps Installations East - Marine Corps Base Camp Lejeune (MCIEAST-MCB CAMLEJ), Jacksonville, North Carolina. Investigation activities were conducted under the Naval Facilities Engineering Command (NAVFAC) Mid-Atlantic, Comprehensive Long-term Environmental Action—Navy (CLEAN) Contract N62470-11-D-8012, Contract Task Order (CTO) WE18. The purpose of the PA/SI was to evaluate the potential presence and nature of environmental contamination, including munitions and explosives of concern (MEC), that may have resulted from historical site activities and to evaluate the risk to potential receptors.

Site UXO-25 is located on the western side of MCIEAST-MCB CAMLEJ, south of the Marine Corps Air Station (MCAS) New River, along U.S. Route 17 near the township of Verona, North Carolina. The site encompasses approximately 25 acres of land located on the west side of U.S. Route 17 and bounded by Old U.S. Route 17. This portion of land was historically a contiguous portion of MCIEAST-MCB CAMLEJ, prior to the relocation of U.S. Route 17 in 1999.

Site UXO-25 lies within portions of two former ranges, Impact Area "M" range and the M-16, Outdoor Classroom range**.** The topography of UXO-25 is relatively flat and heavily vegetated with trees and dense undergrowth. The topography is characterized by low elevations and relatively low relief. Surface elevations range from approximately 50 to 60 feet above mean sea level. The area within UXO-25 is undeveloped, with a small residential area and church located adjacent to the central portion of the munitions response site (MRS) where it is bisected by Verona Loop Road.

During the PA, readily available information about the site and its surrounding area was collected to identify historical activities that may have resulted in the presence of MEC at the site or a release of munitions constituents (MC) to the environment. The SI field activities involved the collection of environmental samples to determine whether hazardous substances are present; to determine if these substances are being released to the environment; and to assess if the substances have reached nearby receptors. Surface soil, subsurface soil, and groundwater samples were collected across the site. Analytical results were screened against applicable regulatory criteria and MCIEAST-MCB CAMLEJ background threshold value (BTV) concentrations and were compared to human health and ecological screening values to evaluate impacts to human health and ecological receptors. Only metals were detected above screening criteria. No unacceptable risks were identified for human or ecological receptors at Site UXO-25.

Digital geophysical mapping (DGM) was conducted over roughly 2.5 acres (10 percent) of UXO-25 along approximately 34,074 linear feet of transects to identify geophysical anomalies representing potential subsurface MEC. A MEC intrusive investigation was conducted by reacquiring all geophysical anomalies that were identified as representing potential subsurface MEC and excavating to determine the source of the anomalies. The DGM investigation identified 361 targets with the characteristics of potential MEC along the transects. The intrusive investigation of these 361 targets did not result in the discovery of any MEC or material potentially presenting an explosive hazard (MPPEH) items.

Based on the results of the environmental and MEC investigations, no further action is recommended for Site UXO-25.

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Acronyms and Abbreviations

°F	degrees Fahrenheit
ASR	Archives Search Report
bgs	below ground surface
BTV	background threshold value
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CLEAN	Comprehensive Long-term Environmental Action—Navy
COPC	chemical of potential concern
CTO	Contract Task Order
DGM	Digital Geophysical Mapping
DPT	direct-push technology
DQO	data quality objective
EcoSSL	Ecological Soil Screening Level
ESS	Explosives Safety Submission
ESV	Ecological Screening Value
GSV	Geophysical System Verification
HHRS	Human Health Risk Screening
HI	hazard index
HQ	hazard quotient
IDW	investigation-derived waste
ISO	industry standard object
IVS	instrument verification strip
m^2	square meter
µg/L	micrograms per liter
MC	munitions constituents
MCAS	Marine Corps Air Station
MCIEAST-MCB CAMLEJ	Marine Corps Installations East – Marine Corps Base Camp Lejeune
MCL	Maximum Contaminant Level
MEC	munitions and explosives of concern
MILCON	military construction
MMRP	Military Munitions Response Program
MPP	Master Project Plans
MPPEH	material potentially presenting an explosive hazard
MRS	Munitions Response Site
MRP	Munitions Response Program
msl	mean sea level
NAVFAC	Naval Facilities Engineering Command
NC	North Carolina
NCDENR	North Carolina Department of Environment and Natural Resources
NCGWQS	North Carolina Groundwater Quality Standards
NC SSL	North Carolina Soil Screening Level
NOAA	National Oceanic and Atmospheric Administration

NRWQC	National Recommended Water Quality Criteria
NTU	Nephelometric Turbidity Unit
PA/SI	Preliminary Assessment/Site Inspection
PETN	pentaerythritol tetranitrate
PID	photoionization detector
PPE	personal protective equipment
PRA	Preliminary Range Assessment
PVC	polyvinyl chloride
QA/QC	quality assurance/quality control
QAPP	Quality Assurance Project Plan
RSL	Regional Screening Level
SOP	Standard Operating Procedure
U.S.	United States
USACE	United States Army Corps of Engineers
USEPA	United States Environmental Protection Agency
UTL	upper tolerance limit
UXO	Unexploded Ordnance
VOC	volatile organic compound

SECTION 1

Introduction

Marine Corps Installations East - Marine Corps Base Camp Lejeune (MCIEAST-MCB CAMLEJ) has completed a Preliminary Assessment/Site Inspection (PA/SI) at Military Munitions Response Program (MMRP) Site Unexploded Ordnance (UXO) 25 – Verona Loop (**Figures 1-1** and **1-2)**. This PA/SI was conducted after a review of records found that the site was included in a portion of two former operational range areas (**Figure 1-3**). The purpose of the PA/SI was to evaluate the potential presence and nature of environmental contamination, including munitions and explosives of concern (MEC), that may have resulted from historical site activities and to evaluate the risk to potential receptors. This report documents the findings of the PA/SI conducted at Site UXO-25.

This PA/SI was conducted by CH2M HILL under the Naval Facilities Engineering Command (NAVFAC) Mid-Atlantic, Comprehensive Long-term Environmental Action—Navy (CLEAN) Contract N62470-11-D-8012, Contract Task Order (CTO) WE18. Site investigation activities were conducted in accordance with the following documents:

- *Preliminary Assessment/Site Inspection Work Plan Addendum, Military Munitions Response Program Site UXO-25 – Verona Loop, Marine Corps Base Camp Lejeune, Jacksonville, North Carolina* (PA/SI Work Plan) (CH2M HILL, 2012).
- *Explosives Safety Submission, Munitions Response Activities, Verona Loop Munitions Response Site (ESS-125), Marine Corps Base Camp Lejeune, North Carolina* (ESS) (CH2M HILL, 2011a).
- *Munitions Response Program (MRP) Master Project Plans* (Munitions Response Program [MRP] Master Project Plans [MPP]) (CH2M HILL, 2008a).
- *Master Project Plans, Marine Corps Base Camp Lejeune (MPP)* (CH2M HILL, 2008b).
- *Investigation and Remediation Waste Management Plan, Marine Corps Base Camp Lejeune, North Carolina* (CH2M HILL, 2011b).

1.1 Objectives and Approach

The purpose of this PA/SI was to evaluate whether Site UXO-25 poses a potential risk to human health and the environment, and whether further investigation is warranted. During the PA, readily available information about the site and its surrounding area was collected to identify historical activities that may have resulted in the presence of MEC or in a release of munitions constituents (MC) to the environment. The SI field activities involved the collection of environmental samples to determine whether hazardous substances are present and are being released to the environment.

In addition to the evaluation of environmental media, the PA/SI also included a geophysical investigation and intrusive investigation to assess the potential presence of MEC.

The objectives of this PA/SI were to:

- Evaluate the presence of potential subsurface MEC
- Evaluate the potential presence of soil and groundwater MC contamination

The activities conducted in support of this PA/SI include the following:

- Conduct an archive search for documents pertaining to the historical uses of UXO-25 that may have resulted in environmental contamination with MEC and/or MC.
- Conduct community outreach to communicate investigation activities to potentially interested parties.
- Site preparation, including vegetation clearance to facilitate digital geophysical mapping (DGM) and environmental sampling activities.

- Evaluate potential impacts from MC to environmental media, including groundwater, surface soil, and subsurface soil, and manage investigation-derived waste (IDW).
- Survey groundwater monitoring well locations.
- Perform DGM over 10 percent of the 25-acre site to identify geophysical anomalies representing potential subsurface MEC.
- Conduct a MEC intrusive investigation by reacquiring all geophysical anomalies that are identified as representing potential subsurface MEC, and excavating to determine the source of the anomalies.

1.2 Report Organization

This PA/SI is divided into sections providing information on the detailed approach, including procedures employed during the execution of the project. This PA/SI is organized as follows:

- **Section 1**, Introduction
- **Section 2**, Site Background
- **Section 3**, Field Investigation Activities
- **Section 4**, Investigation Results
- **Section 5**, Human Health Risk Screening
- **Section 6**, Ecological Risk Screening
- **Section 7**, Conclusions and Recommendations
- **Section 8**, References

Figures and tables are provided at the end of each respective section, and appendixes are provided at the end of this report.

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Legend

- Highways
- UXO-25 - Verona Loop
- Installation Boundary

N

0 7,500 15,000 30,000 Feet

1 inch = 15,000 feet

Figure 1-1
Base Location Map
Site UXO-25 - Verona Loop PA/SI
MCIEAST-MCB CAMLEJ
North Carolina

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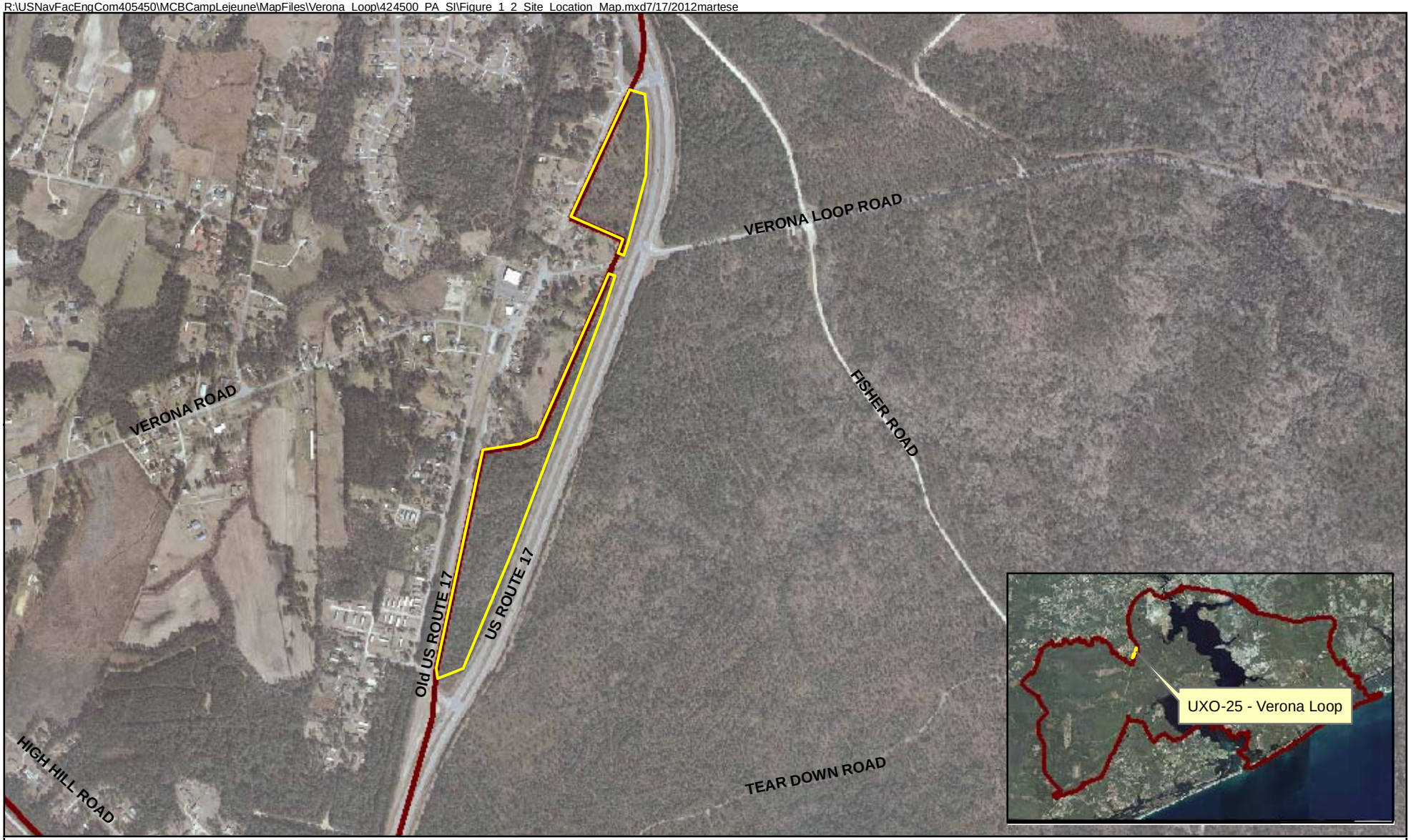

Legend

- UXO-25 - Verona Loop
- Installation Boundary

N

0 500 1,000 2,000 Feet

1 inch = 1,000 feet

Figure 1-2
Site Location Map
Site UXO-25 - Verona Loop PA/SI
MCIEAST-MCB CAMLEJ
North Carolina

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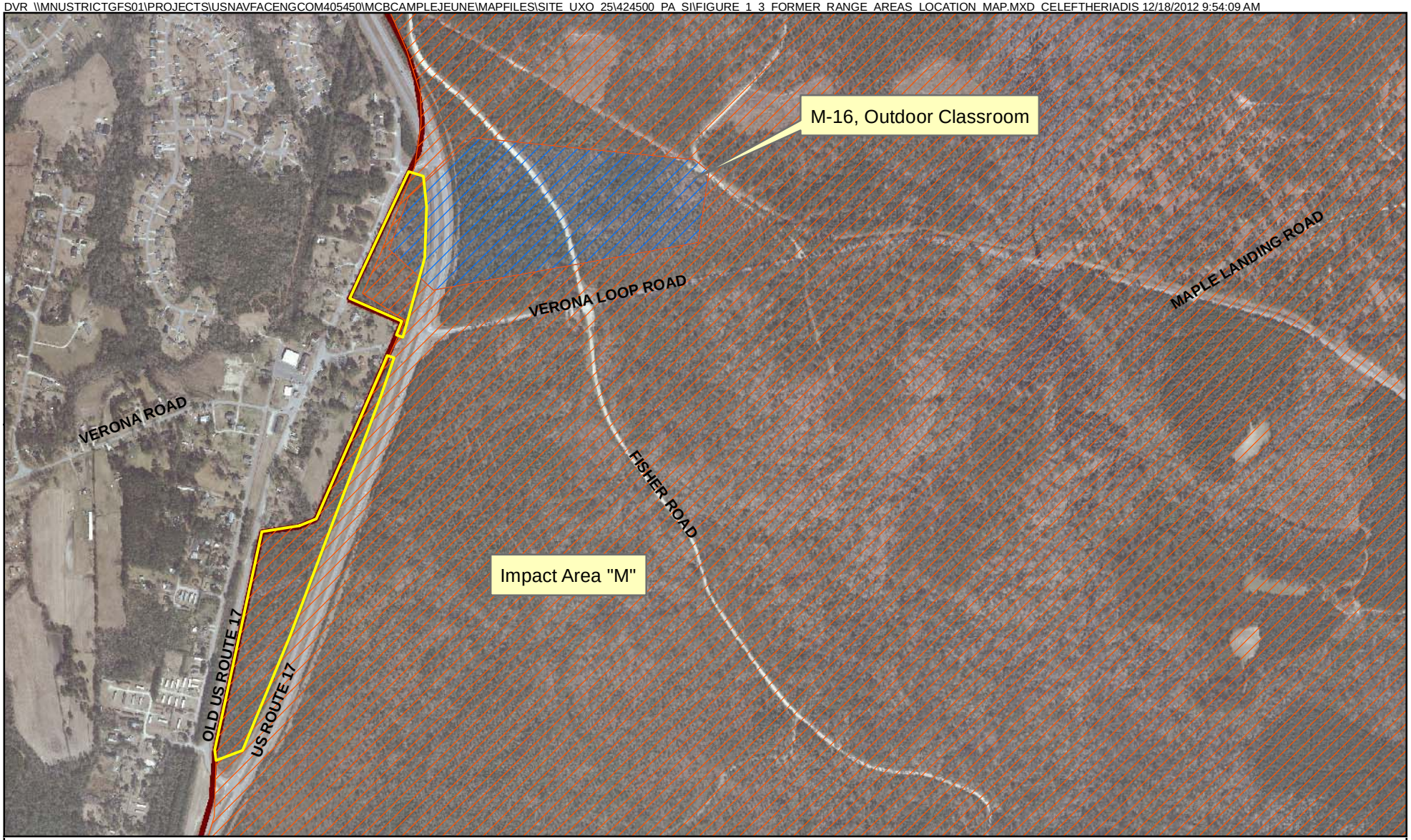

Legend

- UXO-25 - Verona Loop
- Impact Area "M"
- M-16, Outdoor Classroom
- Installation Boundary

N

0 500 1,000 2,000 Feet

1 inch = 1,000 feet

Figure 1-3
Former Range Areas Location Map
Site UXO-25 - Verona Loop PA/SI
MCIEAST-MCB CAMLEJ
North Carolina

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SECTION 2

Site Background

2.1 MCIEAST-MCB CAMLEJ Description

MCIEAST-MCB CAMLEJ is located in Onslow County, North Carolina, covers approximately 236 square miles, and is bisected by the New River, which flows in a southeasterly direction and forms a large estuary before entering the Atlantic Ocean (**Figure 1-1**). The southeastern border of MCIEAST-MCB CAMLEJ is the Atlantic Ocean shoreline. The western and northeastern boundaries are United States (U.S.) Route 17 and State Route 24, respectively. State Highway 50, Haws Run Road, and an unnamed perimeter road border the base to the north and west of the Greater Sandy Run Training Area, which is located west of U.S. Route 17 in the southwestern portion of MCIEAST-MCB CAMLEJ. The City of Jacksonville, North Carolina borders MCIEAST-MCB CAMLEJ to the north (**Figure 1-1**). MCIEAST-MCB CAMLEJ is home to Marine Expeditionary Force units and the base and surrounding community is home to an active duty, dependent, retiree and civilian employee population of approximately 180,000 people.

The generally flat topography of MCIEAST-MCB CAMLEJ is typical of the seaward portions of the North Carolina coastal plain. Elevations vary from sea level to 72 feet above mean sea level (msl), although the elevation of the majority of MCIEAST-MCB CAMLEJ lies between 20 and 40 feet above msl.

2.2 Site UXO-25 Description and History

Site UXO-25 is located on the western side of MCIEAST-MCB CAMLEJ, south of the Marine Corps Air Station (MCAS) New River, along U.S. Route 17 near the township of Verona, North Carolina. The site encompasses approximately 25 acres of land located on the west side of U.S. Route 17 and bounded by Old U.S. Route 17. This portion of land was historically a contiguous portion of MCIEAST-MCB CAMLEJ, prior to the relocation of U.S. Route 17 in 1999. Site UXO-25 lies within portions of two former ranges, Impact Area "M" range and the M-16, Outdoor Classroom range, as shown on **Figure 1-3.**

The topography of UXO-25 is relatively flat and heavily vegetated with trees and dense undergrowth. The topography is characterized by low elevations and relatively low relief. Surface elevations range between approximately 50 and 60 feet above mean sea level. The area within UXO-25 is undeveloped, with a small residential area and church located adjacent to the central portion of the munitions response site (MRS) where it is bisected by Verona Loop Road.

2.3 Site History

A detailed historical review of information related to past uses of UXO-25 was completed in September 2011. Additional information obtained from this review is presented in the Archival Records Search Report (**Appendix A)**. The *Final Range Identification and Preliminary Range Assessment* (PRA) (United States Army Corps of Engineers [USACE], 2001a) and the *Archives Search Report* (ASR) (USACE, 2001b), as well as MCIEAST-MCB CAMLEJ aerial photographs and existing conditions maps, were the primary sources for this historical information. According to the PRA and the ASR, Site UXO-25 consists of those portions of two former ranges, the Impact Area "M" range (ASR #2.211) and the M-16, Outdoor Classroom range (ASR #2.120), that are located west of U.S. Route 17 (**Figure 1-3)**. During the timeframe the ranges were in use, U.S. Route 17 was located west of the range areas. Relocation of U.S. Route 17 in 1999 left approximately 25 acres of the former ranges to the west of U.S. Route 17. This 25-acre area west of U.S. Route 17 is bounded by the Old U.S. Route 17, which borders residential areas of the Verona Township.

Impact Area "M" Range

The former Impact Area "M" range is described as being bounded by U.S. Route 17, Stone Creek, New River, Mill Creek, Verona Loop Road, Lewis Creek, New River, and Southwest Creek (USACE, 2001a). Historical information

indicates that from 1941 to approximately 1945 the area was possibly used for live fire and maneuver exercises with the use of mortars, recoilless rifles, 2.36-inch rockets, and hand and rifle grenades (USACE, 2001b). Camp Training Order 5-1946, dated March 19, 1946, states that the former Impact Area "M" range has been disestablished and is no longer used for the firing of live ammunition (USACE, 2001a).

M-16, Outdoor Classroom

The only reference to the M-16, Outdoor Classroom is a range map dated 1958. Historical range information indicates that 0.30-caliber blanks may have been used, along with pyrotechnics. This area is no longer used for the firing of live ammunition.

Personal communication with Mr. Ben Redmond, a former range control officer at MCIEAST-MCB CAMLEJ, indicated that M-16, Outdoor Classroom was an assembly area consisting of a set of bleachers used for teaching purposes. Mr. Redmond also indicated that "the impact area for mortars and artillery was well to the east (of the subject site), and a lot of the munitions listed (on the PRA) were not used" (Redmond, 2011).

2.4 Regional Geology, Hydrogeology, and Climate

MCIEAST-MCB CAMLEJ is located within the Tidewater region of the Atlantic Coastal Plain Physiographic Province. The area is underlain by an eastward thickening wedge of marine and non-marine sediments ranging in age from early Cretaceous to Holocene. This wedge of sediments begins at the western boundary of the Atlantic Coastal Plain Physiographic Province, known as the Fall Line, and dips and thickens southeastward towards the coast. The sediments occur as layered interfingered beds and lenses of sands, silts, clays, calcareous clays, shell beds, sandstone, and limestone that were deposited over pre-Cretaceous crystalline basement rock. Sedimentary units are often distinguished by minor amounts of detrital carbonate shells, and secondary minerals (Cardinell, Berg, and Lloyd, 1993).

Within the MCIEAST-MCB CAMLEJ area, approximately 1,500 feet of a sedimentary sequence overlies the basement rock and is composed of seven aquifers and their associated confining units. These aquifers include the Surficial, Castle Hayne, Beaufort, Peedee, Black Creek, and Upper and Lower Cape Fear aquifers (Cardinell, Berg, and Lloyd, 1993). Confining units associated with specific aquifers are composed of less permeable beds of clay and silt.

The Surficial aquifer, Upper Castle Hayne Confining Unit, and Castle Hayne Aquifer at MCIEAST-MCB CAMLEJ have all been described (Cardinell, Berg, and Lloyd, 1993). The Surficial aquifer resides within the Undifferentiated Formation of Holocene and Pleistocene age sediments, and the Castle Hayne aquifer resides locally within the River Bend Formation. The upper portion of the River Bend Formation is composed of sands, silts, shell and fossil fragments, and trace amounts of clay. The Belgrade Formation, where present, typically acts as a confining unit between the Surficial and the Castle Hayne aquifers.

In general, natural discharge of groundwater from the Coastal Plain aquifer system is into streams, swamps, and lakes. Evapotranspiration from the vadose zone and upward leakage through confining units into streams, estuaries, swamps, and even the ocean also contribute to groundwater discharge. Within the vicinity of MCIEAST-MCB CAMLEJ, the New River estuary serves as the principal discharge area for groundwater from the Castle Hayne aquifer (Harned et al., 1989).

Mild winters and hot, humid summers generally characterize climatic conditions within southeastern North Carolina (NC) and at MCIEAST-MCB CAMLEJ. Winters are usually short and mild, with occasional brief cold periods. Average annual net precipitation is approximately 54 inches. Ambient air temperatures generally range from 37 to 60 degrees Fahrenheit (°F) in the winter months and 71°F to 88°F during the summer months; summertime humidity averages 75 percent. Winds are generally south-southwesterly in the summer and north-northwesterly in the winter (National Oceanic and Atmospheric Administration [NOAA], 2002).

2.5 Site Geology and Hydrogeology

This section presents the geological and hydrogeological characteristics of Site UXO-25 as indicated by the environmental sampling activities conducted in April 2012. These activities were limited to a depth of approximately 18 feet below ground surface (bgs). Soil boring logs are presented in **Appendix B**.

Given the relatively shallow depths of intrusive investigation activities, this discussion of site-specific geology is limited to the undifferentiated formation that overlies the Belgrade and River Bend Formations. Soil cores recovered from Site UXO-25 consisted of fine to medium-grained sands with varying amounts of silt and clay and deeper layers of sandy clay.

Water level measurements were recorded from monitoring wells VL-MW01 and VL-MW02, which were screened in the surficial aquifer. Depths to groundwater ranged from 5.17 to 6.02 ft bgs (55 and 45.75 feet above mean sea level feet, respectively).

SECTION 3

Field Investigation Activities

The PA/SI field activities were completed at Site UXO-25 between April 2012 and August 2012. Field activities were conducted in accordance with the PA/SI Work Plan and are described below. Throughout the investigation (except during the intrusive investigation of DGM anomalies), UXO technicians conducted MEC avoidance activities in accordance with procedures detailed in the approved ESS, the MRP MPPs (CH2M HILL, 2008b) and in the site-specific health and safety plan (CH2M HILL, 2012).The technical approach included in the PA/SI Work Plan was developed by the MCIEAST-MCB CAMLEJ Tier I Partnering Team, which includes representatives from the Navy, MCIEAST-MCB CAMLEJ, United States Environmental Protection Agency (USEPA) Region 4, and North Carolina Department of Environment and Natural Resources (NCDENR).

3.1 Site Preparation

The following subsections describe the activities associated with site preparation, including preparation for DGM and the environmental investigation.

3.1.1 Vegetation Clearance

In order to allow access to the DGM survey transects and sampling locations, vegetation less than 6 inches in diameter was removed using a track-mounted cutting-mulching machine that cleared a path six feet wide. The area cleared of vegetation was approximately 2.5 acres, as shown on **Figures 3-1** and **3-2**. Overhanging vines and protruding branches that could interfere with the safe and effective use of DGM equipment were also removed.

Prior to mobilization, research was conducted to verify that no federally protected species or archeological sites might be encountered during vegetation clearing activities. No federally listed plant species or potential archeological sites were identified during field activities.

3.1.2 Land Surveying

Land surveying was conducted by ECLS, a professional land surveyor registered in the State of North Carolina, in accordance with Section 7.4 of the MRP MPPs (CH2M HILL, 2008b). Land surveying activities included identification and marking of the Site UXO-25 boundary, layout of DGM transects, determination of coordinates of monitoring wells and environmental sampling locations, and re-acquisition of subsurface geophysical anomalies identified during DGM activities for the intrusive portion of the investigation.

3.1.3 Utility Locating

Prior to initiating drilling and subsurface soil sampling activities, the NC One Call Center was called to identify and mark underground utilities. A third-party professional utilities locator was also subcontracted to identify subsurface structures within 20 feet of proposed drilling or subsurface soil sampling locations. As an additional precaution, a hand auger or post-hole digger was used to clear the first 5 feet of each drilling location.

3.2 Environmental Sampling Activities

In order to assess the potential presence and nature of MC contamination, groundwater, surface soil, and subsurface soil samples were collected from the locations shown on **Figures 3-3** and **3-4**.

3.2.1 Surface Soil Sampling

Sixteen composite surface soil samples (VL-SS01 through VL-SS16) were collected from 0 to 1 feet bgs at the locations identified on **Figures 3-3** and **3-4**. Surface soil samples were collected using the TR-02-1 sampling method, which is described in the United States Army Corps of Engineers Technical Report ERDC/CRREL TR-02-1, *Guide for Characterization of Sites Contaminated with Energetic Materials* (Thiboutot, Ampleman, Hewitt, 2002) and summarized below.

Each sampling location consisted of a square area, 1 meter by 1 meter (1 square meter [m^2]). Coordinates of the sampling locations were based on the center of the sampling area. Soil samples were collected from each sample area by thoroughly mixing a minimum of 30 sample aliquots collected from random locations within the 1-m^2 sampling area, in accordance with the MPPs. Samples were placed in laboratory provided bottleware, preserved according to method requirements, sent to fixed based laboratories TriMatrix Laboratories, Inc. and Columbia Analytical Services, Inc. under chain of custody, and analyzed for the following parameters:

- Explosives residues (nitroaromatics and nitramines), including pentaerythritol tetranitrate (PETN) and nitroglycerin (USEPA SW-846 Methods 8330A and SW-846 8332)
- Perchlorate (USEPA SW-846 Method 6850)
- Total metals (USEPA SW-846 Method 6010C/6020A/7471A)
- Hexavalent chromium (USEPA SW-846 Method 7199)

3.2.2 Subsurface Soil Sampling

A total of 16 subsurface soil samples (designated VL-IS01 through VL-IS16 [co-located with surface soil samples]) were collected at the locations shown on **Figures 3-3** and **3-4.** A track-mounted direct-push technology (DPT) rig was used to collect subsurface soil samples at locations VL-IS01 and VL-IS15, which were co-located with the monitoring well locations, and the remaining samples were collected with a hand auger. Subsurface soil samples were composited from 1 foot bgs to approximately 2 feet above the water table which ranged from 4 to 6.5 feet bgs.

Continuous soil cores were collected for subsurface soil samples at locations VL-IS01 and VL-IS15 in disposable acetate sleeves using a DPT macro-core soil sampler, and screened for the presence of volatile organic compounds (VOCs) using a photoionization detector (PID). The soil cores were inspected by CH2M HILL technical staff and described using the Unified Soil Classification System. No staining or odors were observed during sampling activities. Boring logs for these locations are included in **Appendix B**.

Samples were placed in laboratory provided bottleware, preserved according to method requirements, sent to fixed based laboratories TriMatrix Laboratories, Inc. and Columbia Analytical Services, Inc. under chain of custody, and analyzed for the following parameters:

- Explosives residues (nitroaromatics and nitramines), including PETN and nitroglycerin (USEPA SW-846 Methods 8330A and SW-846 8332)
- Perchlorate (USEPA SW-846 Method 6850)
- Total metals (USEPA SW-846 Method 6010C/6020A/7471A)
- Hexavalent chromium (USEPA SW-846 Method 7199)

3.2.3 Monitoring Well Installation and Groundwater Sampling

Two permanent surficial aquifer monitoring wells (VL-MW01 and VL-MW02) were installed using hollow stem auger drilling methods at the locations shown on **Figures 3-3** and **3-4**. Well construction details, groundwater levels, and water quality parameters for the monitoring wells are included in **Tables 3-1 and 3-2**. Boring logs and well construction diagrams are included in **Appendix B**. These permanent monitoring wells were installed in accordance with the MPPs (CH2M HILL, 2008a).

The monitoring wells were constructed using 2-inch diameter Schedule 40 polyvinyl chloride (PVC) riser with 10-feet of 0.010-inch slotted PVC screens. Monitoring well VL-MW01 was installed to a total depth of 15.5 ft bgs and the well screen bracketed the water table which was present at 5.17 ft bgs at this location. Monitoring well VL-MW02 was installed to a total depth of 18 ft bgs with a screened interval of 8 to 18 ft bgs. The water table at monitoring well VL-MW02 was present at 6.02 ft bgs.

A 30/40 silica sand filter pack was placed in the annular space between each well screen and borehole wall, from the bottom of the borehole to approximately 2 feet above the top of the well screen. Bentonite pellets were placed on top of each filter pack and hydrated (for at least 1 hour) to form a seal approximately 2 feet thick. After hydration of the bentonite pellets, the remaining annular space of the boreholes was grouted to within 1 foot of the ground surface. The grout was then allowed to cure a minimum of 24 hours prior to well completion. Each monitoring well was completed approximately 3 feet above ground surface with a lockable, steel protective stickup cover and 2-feet x 2-feet x 4-inch concrete pad. Concrete bollards (3.5-feet tall and 4-inch diameter) were placed around the concrete pad, and each was painted bright yellow. Sand was placed in the annular space between the riser and protective cover. A watertight expansion plug was installed on top of the 2-inch diameter casing, well identification tags were attached to the outside of the steel protective cover, and the steel protective casing was locked.

All drilling and well installation activities were conducted by Mid-Atlantic Drilling, a North Carolina-certified well contractor, in accordance with the NC Well Construction Standards.

Well Development

Each new monitoring well was developed at least 24 hours after installation. Wells were developed in accordance with CH2M HILL Standard Operating Procedures (SOPs) and the MPPs (CH2M HILL, 2008a). Well development included surging and over-pumping with a submersible pump across the length of the well screen. Well development was considered complete when the development water was clear of visible sediment and the groundwater geochemical parameters (pH, specific conductance, turbidity, and temperature).

Purging and Sampling

Groundwater samples were collected from the monitoring wells as shown on **Figures 3-3** and **3-4**. Groundwater samples were placed in laboratory provided bottleware, preserved according to method requirements, sent to fixed based laboratories TriMatrix Laboratories, Inc. and Columbia Analytical Services, Inc. under chain of custody, and analyzed for the following parameters:

- Explosives residues (nitroaromatics and nitramines), including PETN and nitroglycerin (USEPA SW-846 8330A and SW-846 8332)
- Perchlorate (SW-846 USEPA Method 6850)
- Total metals (USEPA SW-846 Methods 6010C/6020A/7470A)
- Hexavalent chromium (USEPA SW-846 Method 7199)
- Dissolved metals (USEPA SW-846 6010C/6020A/7470A)

The wells were purged using low-flow methods in accordance with CH2M HILL SOPs, and the MPPs (CH2M HILL, 2008a). Groundwater quality parameters recorded at the time of sampling are included in **Table 3-2**.

3.2.4 Quality Assurance/Quality Control

Quality assurance/quality control (QA/QC) sampling was performed in accordance with CH2M HILL protocols (MPPs) as outlined in the Quality Assurance Project Plan (QAPP) in the PA/SI Work Plan (CH2M HILL, 2012), and included the collection of equipment blanks, duplicates, and matrix spike/matrix spike duplicates. Analytical data was validated by a third-party data validation subcontractor (DataQual Environmental Services, LLC) as explained in the Quality Assurance Project Plan (CH2M HILL, 2012).

3.2.5 Investigative-derived Waste Management

IDW was disposed in accordance with the MCIEAST-MCB CAMLEJ Investigation and Remediation Waste Management Plan (CH2M HILL, 2011b). IDW generated during the field event consisted of soil cuttings from the installation of monitoring wells, well development and purge water, decontamination fluids, disposable equipment, and personal protective equipment (PPE). Soil from the subsurface soil sampling locations that were

collected with a hand auger was spread around the borehole. Soil from the monitoring well installation and development fluids, purge water, and decontamination fluids were containerized in 55-gallon drums and disposed of as non-hazardous waste at the off-site Clearfield MMG, Inc. Chesapeake, Virginia disposal facility. The non-hazardous shipping manifest is included in **Appendix C**. Disposable equipment, including PPE, poly sheeting, paper towels, and aluminum foil, was disposed of in a MCIEAST-MCB CAMLEJ trash receptacle.

3.3 Geophysical Investigation

DGM was conducted over approximately 2.5 acres (10 percent) of UXO-25, as shown on **Figures 3-1** and **3-2**, to identify anomalies that represent potential subsurface MEC. The DGM survey was performed along regularly spaced transects across the site, with a narrow buffered area between transects and the property boundary to maintain the safety exclusion zones in the approved ESS during the intrusive investigation. A summary of the work performed is provided as follows; the complete Geophysical Investigation Report is provided in **Appendix D**.

3.3.1 Digital Geophysical Mapping Survey

Prior to conducting the DGM survey at Site UXO-25, survey stakes were installed along the DGM transects approximately every 20 meters; the survey information for these stakes were incorporated into the DGM data collected during the DGM survey. The locations and actual spacing of the DGM transects were based on specific site conditions (e.g., accessibility). Approximately 34,074 linear feet of transect data was collected covering approximately 10 percent of Site UXO-25, approximately 2.5 acres.

The DGM data was collected using a Geonics Two Coil EM61-MK2 Electromagnetic System (EM61-MK2). The EM61-MK2 is a high-resolution time-domain electromagnetic instrument designed to detect, with high spatial resolution, ferrous and non-ferrous metallic objects.

3.3.2 Geophysical Systems Verification

Prior to the commencement of DGM, a Geophysical Systems Verification (GSV) was completed for the testing, evaluation, and determination that the selected geophysical equipment met existing project data quality objectives (DQOs). The GSV is a physics-based, presumptively selected technology process in which signal strength and sensor performance are compared to known response curves of industry standard objects (ISOs) to verify DGM systems before and during site surveys. The GSV process is designed to perform initial verification of the DGM system using an instrument verification strip (IVS), followed by a blind seeding program for continued verification throughout the field operations. A copy of the GSV Report is included as an attachment to the Geophysical Report in **Appendix D**.

3.3.3 Data Quality Objectives

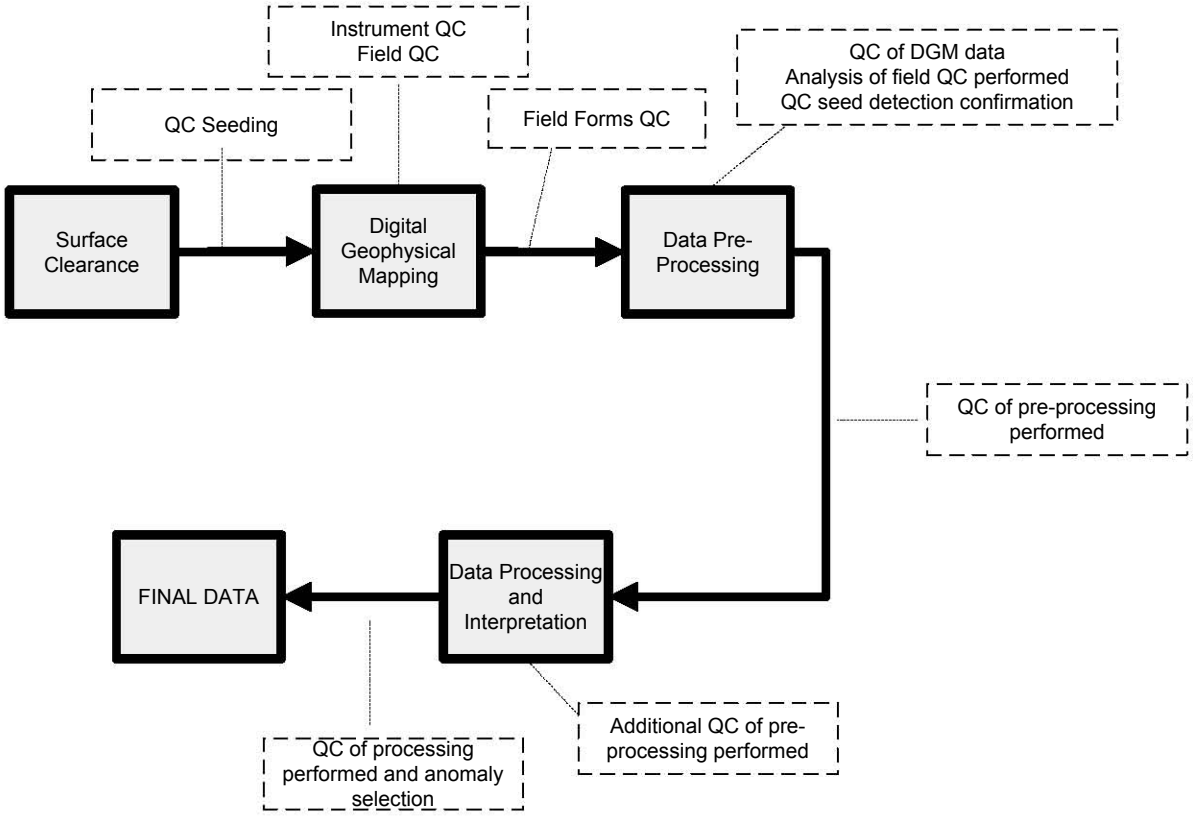
All DQOs outlined in the PA/SI Work Plan (CH2M HILL, 2012) were met during the DGM survey.

3.3.4 Quality Control

An extensive QC program was applied to the DGM operations at the site. **Figure 3-5** shows an overall chart of the QC steps. The geophysical system was field tested as specified in the PA/SI Work Plan (CH2M HILL, 2012). CH2M HILL performed QC geophysical data and data deliverables at each step of the processing path.

All tests outlined in the PA/SI Work Plan were performed on the DGM instruments at the appropriate intervals (e.g., daily, weekly, at start of project). Results were checked by CH2M HILL's QC geophysicist to ensure that all instruments functioned as required.

FIGURE 3-5
Overview of DGM Process QC



3.4 Intrusive Investigation

Based on the results of the DGM survey, intrusive investigation of 361 subsurface geophysical anomalies was conducted to evaluate the nature and density of MEC that may be present at the site.

Intrusive investigation operations were performed using hand excavation procedures to identify the source of individual anomalies following reacquisition of each anomaly. One hundred percent of the selected anomalies identified during the DGM investigation were intrusively investigated. Included in the anomalies for excavation were the QC seeds placed in the investigation areas prior to the DGM investigation.

TABLE 3-1

Monitoring Well Construction Information and Groundwater Elevation Data

Site UXO-25 - Verona Loop PA/SI

MCIEAST-MCB CAMLEJ

North Carolina

Well ID	Aquifer	Total Well Depth (ft bgs)	Screen Length (ft)	Screen Interval (ft bgs)	Measured Well Depth (ft btoc)	Top of Casing Elevation	Ground Surface Elevation (feet msl)	Depth to Water April 2012 (ft btoc)	Depth to Water April 2012 (ft bgs)	Depth to Water April 2012 (ft msl)
VL-MW01	Surficial	15.5	10	5 - 15	18.80	63.25	60.17	8.25	5.17	55.00
VL-MW02	Surficial	18.0	10	8 - 18	21.14	55.35	51.77	9.60	6.02	45.75

Notes:

Groundwater gauging completed on April 26, 2012

2-inch diameter 0.010-inch machine slot Sch. 40 PVC screen used

bgs - below ground surface

ft - feet

ft bgs - feet below ground surface

msl - mean sea level

TABLE 3-2

Summary of Groundwater Quality Parameters

Site UXO-25 - Verona Loop PA/SI

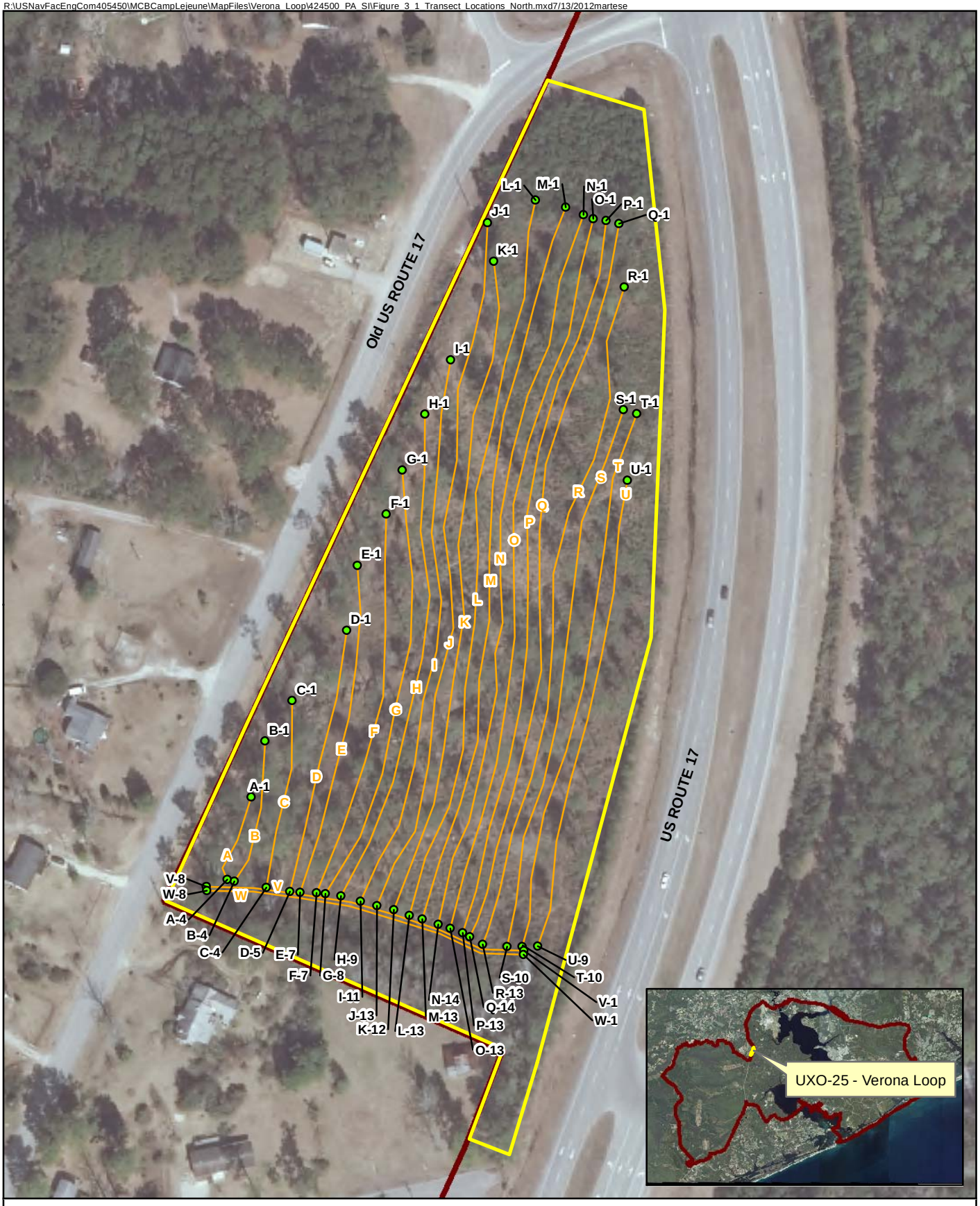
MCIEAST-MCB CAMLEJ

North Carolina

Well ID	Date	DO (MG/L)	EH/ORP (MV)	PH (SU)	SC (MS/CM)	TEMP (DEG C)	TURB (NTU)
Surficial Aquifer							
VL-MW01	4/26/2012	4.82	4.6	5.17	0.072	20.77	1.7
VL-MW02	4/26/2012	6.95	174.2	4.79	0.068	19.63	9.1

Notes:
NA - Not available
DO - Dissolved Oxygen
EH/ORP - Oxidation Potential
FE2+ - Ferrous Iron
NO3 - Nitrate
SU - Scientific Units
PNO2 - Nitrite
SC - Specific Conductivity
TEMP - Temperature
TURB - Turbidity
MG/L - milligram per liter
MV - millivolts
PH - standard units
MS/CM - milli-Siemens per centimeter
DEG C - degree Celsius
NTU - Nephelometric Turbidity Units

R:\USNavFacEngCom405450\MCBCampLejeune\MapFiles\Verona_Loop\424500_PA_SI\Figure_3_1_Transect_Locations_North.mxd7/13/2012martese



Legend

- DGM Transect End Points
- DGM Transects
- UXO-25 - Verona Loop
- Installation Boundary

N

0 75 150 Feet

1 inch = 150 feet

Figure 3-1
Transect Locations - North
Site UXO-25 - Verona Loop PA/SI
MCIEAST-MCB CAMLEJ
North Carolina

CH2MHILL

Legend

- DGM Transect End Points
- DGM Transects
- UXO-25 - Verona Loop
- Installation Boundary

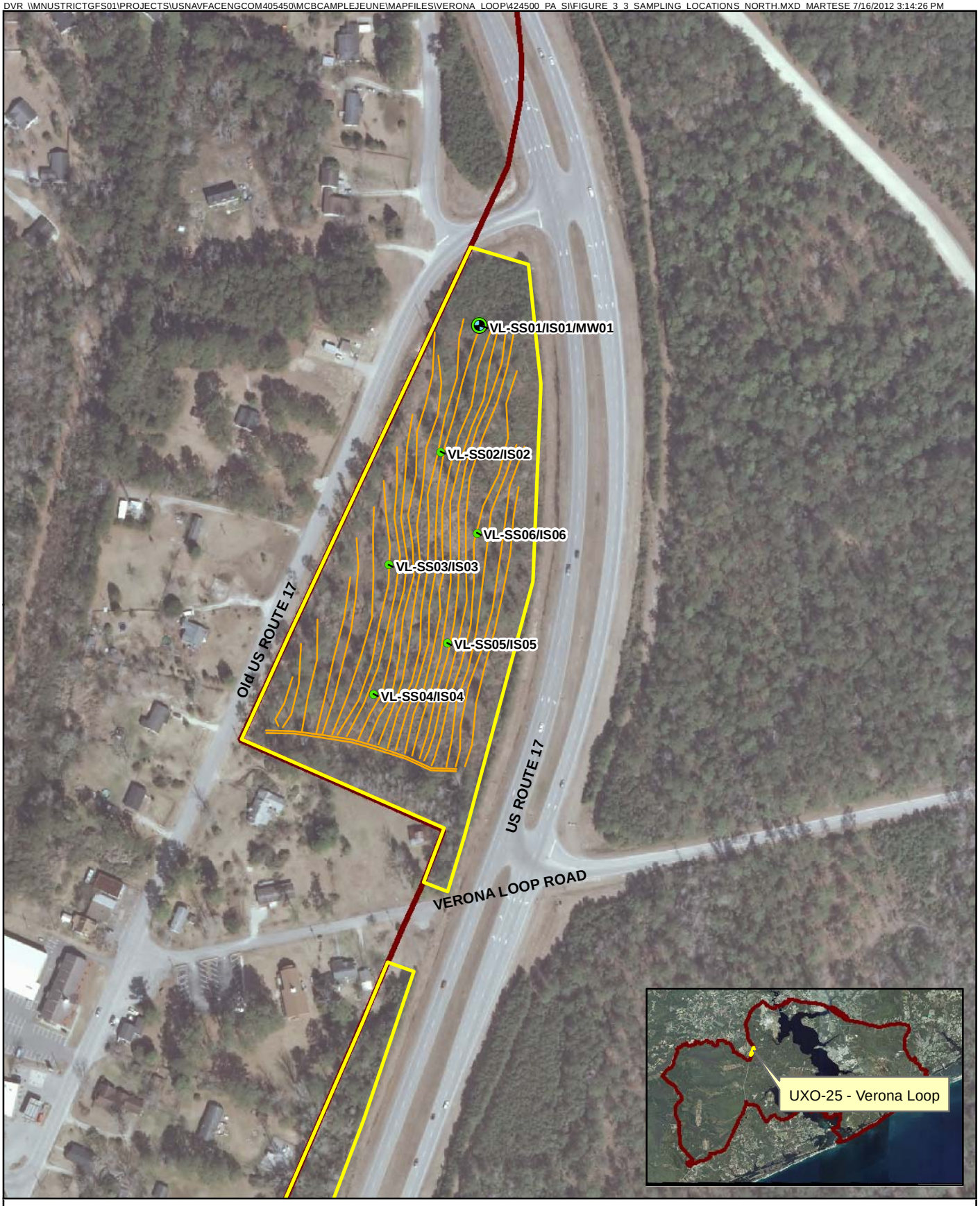
N

0 100 200 Feet

1 inch = 200 feet

Figure 3-2
Transect Locations - South
Site UXO-25 - Verona Loop PA/SI
MCIEAST-MCB CAMLEJ
North Carolina

CH2MHILL



Legend

- Surface/Subsurface Soil Sampling Locations
- Surface/Subsurface Soil and Groundwater Sampling Locations
- DGM Transects
- UXO-25 - Verona Loop
- Installation Boundary

N

0 125 250 Feet

1 inch = 250 feet

Figure 3-3
Sampling Locations - North
Site UXO-25 - Verona Loop PA/SI
MCIEAST-MCB CAMLEJ
North Carolina

CH2MHILL

Legend

- Surface/Subsurface Soil Sampling Locations
- Surface/Subsurface Soil and Groundwater Sampling Locations
- DGM Transects
- UXO-25 - Verona Loop
- Installation Boundary

N

0 125 250 Feet

1 inch = 250 feet

Figure 3-4
Sampling Locations - South
Site UXO-25 - Verona Loop PA/SI
MCIEAST-MCB CAMLEJ
North Carolina

CH2MHILL

SECTION 4

Investigation Results

This section presents the findings of the field investigation activities conducted at Site UXO-25 between April and August 2012.

4.1 Environmental Investigation Results

The following subsections present and summarize the laboratory data from analysis of soil and groundwater samples collected. The exceedances of screening criteria and regulatory standards are included in **Tables 4-1** through **4-3** and shown on **Figures 4-1** through **4-6**. Summaries of the exceedances are included in **Tables 4-4** through **4-5** below. All validated analytical data can be found in **Appendix E**.

4.1.1 Surface Soil

The analytical data for the 16 surface soil samples were compared to the North Carolina Soil Screening Levels (NC SSLs) (NCDENR, 2010a), the USEPA Adjusted Residential Soil Regional Screening Levels (RSLs) (USEPA, 2012), USEPA Adjusted Industrial Soil RSLs (USEPA, 2012), and MCIEAST-MCB CAMLEJ background threshold values (BTVs) for combined soil type for Undeveloped Areas (CH2M HILL, 2011c) (**Table 4-1**).

There were no detections for explosives residues above method detection limits in surface soil samples. Perchlorate was detected in only one surface soil sample (VL-SS05-12B), but no regulatory standards were exceeded. Six metals (aluminum, arsenic, cobalt, iron, manganese, and vanadium) were detected in at least 1 of the 16 surface soil samples in exceedance of both the BTV and at least one of the regulatory criteria (**Table 4-4**). These results are also presented on **Figures 4-1** and **4-2**.

TABLE 4-4
Surface Soil Exceedance Summary

	Criteria				Exceedance Summary		
Analyte	BTV Undeveloped Combined SS (Aug 2011)	NC SSLs (Feb 2012)	Adjusted Industrial Soil RSLs (May 2012)	Adjusted Residential Soil RSLs (May 2012)	Frequency of Exceedances	Maximum Concentration	Maximum Concentration Location
Aluminum	12,800	--	99,000	7,700	3/16	18,000	VL-SS14-12B
Arsenic	1.17	5.8	1.6	0.39	5/16	6.9	VL-SS08-12B
Cobalt	0.414	0.9	30	2.3	1/16	1.6	VL-SS08-12B
Iron	7,210	150	72,000	5,500	1/16	9,000	VL-SS08-12B
Manganese	37	65	2,300	180	1/16	79	VL-SS08-12B
Vanadium	17.6	6	520	39	2/16	29	VL-SS08-12B

Notes:
Values in milligrams per kilogram (mg/kg)
SS – surface soil

4.1.2 Subsurface Soil

The analytical data for the 14 subsurface soil samples were compared to the NC SSLs (NCDENR, 2010a), the USEPA Adjusted Residential Soil RSLs (USEPA, 2012), the USEPA Adjusted Industrial Soil RSLs (USEPA, 2012), and the MCIEAST-MCB CAMLEJ BTVs for Undeveloped Areas (Combined Soil Types) (CH2M HILL, 2011c) (**Table 4-2**).

There were no detections for explosives residues or perchlorate above method detection limits in the subsurface soil samples. Hexavalent chromium was the only metal detected in exceedance of both the BTV and at least one of the regulatory criteria, in 10 of 16 samples collected (**Table 4-5** and **Figures 4-3** and **4-4**).

TABLE 4-5
Subsurface Soil Exceedance Summary

	Criteria				Exceedance Summary		
Analyte	BTV Undeveloped Combined SB (Aug 2011)	NC SSLs (Feb 2012)	Adjusted Industrial Soil RSLs (May 2012)	Adjusted Residential Soil RSLs (May 2012)	Frequency of Exceedances	Maximum Concentration	Maximum Concentration Location
Chromium (hexavalent)	3.74	3.8	5.6	0.29	10/16	6.59 J-	VL-SB11-1-4-12B

Notes:

Values in milligrams per kilogram (mg/kg)
J- – Analyte present, value may be biased low, actual value may be higher
SB – subsurface soil

4.1.3 Groundwater

Groundwater analytical results from the two monitoring wells were compared to the North Carolina Groundwater Quality Standards (NCGWQS) (NCDENR, 2010), the USEPA Adjusted Tap Water RSLs, and the MCIEAST-MCB CAMLEJ surficial aquifer groundwater BTVs (CH2M HILL, 2011d) (**Table 4-3**).

There were no detections of explosives residues or perchlorate above method detection limits in the groundwater samples. Additionally, there were no metals detected in exceedance of the BTVs and regulatory standards.

4.2 Geophysical and Intrusive Investigation Results

4.2.1 Digital Geophysical Mapping Results

The results of the DGM are presented as **Figures 4-7** and **4-8**. These figures depict the UXO-25 northern and southern area results, respectively. DGM data was collected over approximately 10 percent of Site UXO-25. A total of 904 targets were selected from the DGM data, but of these, 361 were identified as targets with the characteristics of potential MEC based on an electromagnetic response greater than 3 millivolts. The remainder of the targets appeared to be associated with electromagnetic noise from the power lines along Old U.S. Route 17. Four of the targets identified represent the QC seed locations that were successfully detected as part of the GSV process. The Geophysical Investigation Report is provided in **Appendix D**.

4.2.2 Intrusive Investigation Results

The intrusive investigation of 361 anomalies identified during the DGM survey (**Figures 4-7** and **4-8**) did not recover any MEC, material potentially presenting an explosive hazard (MPPEH), or munitions-related debris. The cultural debris recovered during the intrusive investigation included steel cable, empty rusted food cans, nails, automobile body parts, tin roofing, aluminum foil, and wire.

TABLE 4-1

Surface Soil Analytical Data Exceedances

Site UXO-25 - Verona Loop PA/SI

MCIEAST-MCB CAMLEJ

North Carolina

Station ID	BTV (Undeveloped SS Combined Soil) (Aug 2011)	NCSSL (Feb 2012)	Adjusted Industrial Soil RSLs (May 2012)	Adjusted Residential Soil RSLs (May 2012)	VL-MW01	VL-IS02	VL-IS03		VL-IS04	VL-IS05	VL-IS06	VL-IS07	VL-IS08	VL-IS09
Sample ID					VL-SS01-12B	VL-SS02-12B	VL-SS03-12B	VL-SS03D-12B	VL-SS04-12B	VL-SS05-12B	VL-SS06-12B	VL-SS07-12B	VL-SS08-12B	VL-SS09-12B
Sample Date					04/25/12	04/25/12	04/25/12	04/25/12	04/25/12	04/25/12	04/25/12	04/25/12	04/25/12	04/26/12
Chemical Name														
Explosives (µg/kg)														
Perchlorate	--	--	72,000	5,500	1.1 U	1.3 U	1.5 U	1.4 U	1.2 U	0.84 J	1.3 U	1.2 U	1.6 U	1.3 U
Total Metals (mg/kg)														
Aluminum	12,800	--	99,000	7,700	750	3,300	6,900	7,300	4,900	2,500	6,300	3,600	15,000	7,600
Antimony	1.87	0.9	41	3.1	0.053 J	0.081 J	0.32	0.092 J	0.053 J	0.11 J	0.044 J	0.025 J	0.33	0.059 J
Arsenic	1.17	5.8	1.6	0.39	0.28 J	0.68	1	1.1	0.63	0.49 J	0.69	0.57	**6.9**	1.2
Barium	36.7	580	19,000	1,500	2.4	7.5	16	15	5.2	5.4	12	7.2	36	15
Beryllium	0.195	63	200	16	0.05 U	0.053 J	0.055 J	0.13	0.025 J	0.03 J	0.058 J	0.034 J	0.37	0.13
Cadmium	0.2	3	80	7	0.016 J	0.01 J	0.03 J	0.058	0.0079 J	0.041 J	0.02 J	0.01 J	0.15	0.033 J
Calcium	8,470	--	--	--	97	72	450	430	68	120	220	76	4,200	720
Chromium (hexavalent)	2.73	3.8	5.6	0.29	0.22 UJ	1.92 J-	0.29 UJ	0.26 UJ	0.31 J-	0.23 UJ	0.27 UJ	0.29 J-	0.3 UJ	0.25 UJ
Chromium	17.4	3.8	5.6	0.29	0.81 J	3.8 J	5 J	**6.3 J**	3.9 J	2.2 J	5.2 J	2.8 J	**16 J**	**5.6 J**
Cobalt	0.414	0.9	30	2.3	0.032 J	0.21	0.21 J	0.29 J	0.13	0.073 J	0.2	0.13	1.6	0.32
Copper	17.1	700	4,100	310	0.38	0.63	1.1	1.4	0.33	2.6	1	0.51	6.7	1.2
Iron	7,210	150	72,000	5,500	570	1,000	3,600	3,600	3,200	1,500	2,500	2,000	9,000	3,000
Lead	27.5	270	800	400	4.7	9.8	38	12	6.3	5.8	7.1	5.6	42	10
Magnesium	904	--	--	--	32 J	60	140	130	110	49 J	130	75	420	180
Manganese	37	65	2,300	180	3	1.9	5.8 J	14 J	3.9	2.3	4	6.2	79	4.3
Mercury	0.161	1	31	2.3	0.009 J	0.024 J	0.027 J	0.057	0.021 J	0.018 J	0.021 J	0.019 J	0.054	0.032 J
Nickel	3.11	130	2,000	150	1.3 J	3.5 J	5.9 J	8.3 J	3.1 J	3.1 J	3.9 J	3 J	4.6 J	2.6 J
Potassium	359	--	--	--	41 J	91	140	130	88	41 J	130	83	470	210
Selenium	1.59	2.1	510	39	0.11 J	0.37 J	0.52	0.55	0.21 J	0.24 J	0.4 J	0.15 J	1.2	0.53
Silver	0.354	3.4	510	39	0.01 U	0.0044 J	0.006 J	0.0078 J	0.01 U	0.01 U	0.007 J	0.01 U	0.021 J	0.0087 J
Sodium	250	--	--	--	25 U	23 U	25 U	25 U	23 U	25 U	25 U	25 U	95	22 J
Thallium	--	0.28	1	0.078	0.01 J	0.021 J	0.05 J	0.087 J	0.029 J	0.033 J	0.043 J	0.037 J	0.13	0.053 J
Vanadium	17.6	6	520	39	2.5 J	4.2 J	7.4 J	9.1 J	7.3 J	3.1 J	7 J	5.3 J	29 J	9.7 J
Zinc	28.6	1,200	31,000	2,300	2.1	2.4	5.1 J	10 J	2.5	2.6	3.4	2.3	120	7.4

Notes:

Shading indicates exceedance of the base background undeveloped combined concentration for surface soil

Bold box indicates exceedance of NC SSL

Bold text indicates exceedance of Adjusted Industrial Soil RSLs

Underline indicates exceedance of Adjusted Residential Soil RSLs

RSLs were adjusted for noncarcinogens to account for exposure to multiple constituents

BTV - Background Threshold Values for MCIEAST-MCB CAMLEJ

J - Analyte present, value may or may not be accurate or precise

J- - Analyte present, value may be biased low, actual value may be higher

U - The material was analyzed for, but not detected

UJ - Analyte not detected, quantitation limit may be inaccurate

mg/kg - Milligrams per kilogram

µg/kg - Micrograms per kilogram

TABLE 4-1

Surface Soil Analytical Data Exceedances

Site UXO-25 - Verona Loop PA/SI

MCIEAST-MCB CAMLEJ

North Carolina

Station ID	BTV (Undeveloped SS Combined Soil) (Aug 2011)	NCSSL (Feb 2012)	Adjusted Industrial Soil RSLs (May 2012)	Adjusted Residential Soil RSLs (May 2012)	VL-IS10	VL-IS11	VL-IS12	VL-IS13	VL-IS14		VL-MW02	VL-IS16
Sample ID					VL-SS10-12B	VL-SS11-12B	VL-SS12-12B	VL-SS13-12B	VL-SS14-12B	VL-SS14D-12B	VL-SS15-12B	VL-SS16-12B
Sample Date					04/25/12	04/26/12	04/26/12	04/26/12	04/26/12	04/26/12	04/25/12	04/26/12
Chemical Name												
Explosives (µg/kg)												
Perchlorate	--	--	72,000	5,500	1.2 U	1.3 U	1.4 U	1.2 U	1.5 U	1.5 U	1.2 U	1.5 U
Total Metals (mg/kg)												
Aluminum	12,800	--	99,000	7,700	1,100	6,400	16,000	7,500	18,000	15,000	1,500	9,700
Antimony	1.87	0.9	41	3.1	0.05 U	0.05 U	0.052 J	0.047 J	0.13 J	0.11 J	0.054 J	0.054 J
Arsenic	1.17	5.8	1.6	0.39	0.34 J	0.75	**2.2**	**1.6**	**2.1**	**1.9**	0.47 J	0.93
Barium	36.7	580	19,000	1,500	4.2	8.8	20	5.6	31	27	6	12
Beryllium	0.195	63	200	16	0.046 U	0.11	0.3	0.033 J	0.3	0.32	0.025 J	0.12
Cadmium	0.2	3	80	7	0.013 J	0.0043 J	0.018 J	0.0059 J	0.058	0.055	0.0097 J	0.016 J
Calcium	8,470	--	--	--	89	50 U	110	50 U	720	570	190	110
Chromium (hexavalent)	2.73	3.8	5.6	0.29	0.23 UJ	0.5 J-	0.41 J-	0.58 J-	0.26 J-	0.28 J-	0.24 UJ	0.97 J-
Chromium	17.4	3.8	5.6	0.29	0.96 J	5.5 J	**12 J**	**6.5 J**	**12 J**	**12 J**	1.9 J	**6.4 J**
Cobalt	0.414	0.9	30	2.3	0.046 J	0.17	0.56	0.36	0.73	0.62	0.056 J	0.28
Copper	17.1	700	4,100	310	0.41	0.31	0.77	1.8	2.4	1.9	0.34	0.46
Iron	7,210	150	72,000	5,500	880	1,600	4,300	3,600	4,700	3,700	740	2,200
Lead	27.5	270	800	400	2.8	6.5	12	9	56	46	7	11
Magnesium	904	--	--	--	32 J	140	370	170	380	310	59	240
Manganese	37	65	2,300	180	3.3	2.9	4.7	3.3	4.7	4.3	2.6	3.7
Mercury	0.161	1	31	2.3	0.014 J	0.017 J	0.055	0.016 J	0.075	0.063	0.014 J	0.031 J
Nickel	3.11	130	2,000	150	2.4 J	0.74 J	2.8 J	1.9 J	3.6 J	4.9 J	0.85 J	4.3 J
Potassium	359	--	--	--	58	180	440	170	420	350	68	310
Selenium	1.59	2.1	510	39	0.14 J	0.34 J	1.2	0.24 J	0.75	0.74	0.23 J	0.47 J
Silver	0.354	3.4	510	39	0.0093 U	0.01 U	0.0088 J	0.0046 J	0.017 J	0.018 J	0.01 U	0.007 J
Sodium	250	--	--	--	25 U	8.3 J	22 J	6.7 J	34 J	28 J	25 U	21 J
Thallium	--	0.28	1	0.078	0.015 J	0.043 J	0.13	0.046 J	0.11	0.1	0.011 J	0.063 J
Vanadium	17.6	6	520	39	2.8 J	8 J	19 J	12 J	16 J	14 J	2.7 J	8.3 J
Zinc	28.6	1,200	31,000	2,300	1.6 J	1.3 J	6.3	5.4	11	9.2	1.4 J	4.5

Notes:

Shading indicates exceedance of the base background undeveloped combined concentration for surface soil

Bold box indicates exceedance of NC SSL

Bold text indicates exceedance of Adjusted Industrial Soil RSLs

Underline indicates exceedance of Adjusted Residential Soil RSLs

RSLs were adjusted for noncarcinogens to account for exposure to multiple constituents

BTV - Background Threshold Values for MCIEAST-MCB CAMLEJ

J - Analyte present, value may or may not be accurate or precise

J- - Analyte present, value may be biased low, actual value may be higher

U - The material was analyzed for, but not detected

UJ - Analyte not detected, quantitation limit may be inaccurate

mg/kg - Milligrams per kilogram

µg/kg - Micrograms per kilogram

TABLE 4-2

Subsurface Soil Analytical Data Exceedances

Site UXO-25 - Verona Loop PA/SI

MCIEAST-MCB CAMLEJ

North Carolina

Station ID	BTV (Undeveloped SB Combined Soil) (Aug 2011)	NC SSL (Feb 2012)	Adjusted Industrial Soil RSLs (May 2012)	Adjusted Residential Soil RSLs (May 2012)	VL-MW01	VL-IS02	VL-IS03		VL-IS04	VL-IS05	VL-IS06	VL-IS07	VL-IS08
Sample ID					VL-SB01-1-6-12B	VL-SB02-1-5-12B	VL-SB03-1-5-12B	VL-SB03D-1-5-12B	VL-SB04-1-5-12B	VL-SB05-1-5-12B	VL-SB06-1-5-12B	VL-SB07-1-4-12B	VL-SB08-1-4-12B
Sample Date					04/24/12	04/25/12	04/25/12	04/25/12	04/25/12	04/25/12	04/25/12	04/25/12	04/25/12
Chemical Name													
Explosives (µg/kg)													
No Detections													
Total Metals (mg/kg)													
Aluminum	19,000	--	99,000	7,700	4,100	10,000	13,000	14,000	7,100	8,000	10,000	11,000	13,000
Antimony	1.1	0.9	41	3.1	0.05 U	0.046 U	0.054 J	0.05 J	0.055 J	0.069 J	0.033 J	0.033 J	0.17 J
Arsenic	5.09	5.8	1.6	0.39	0.57	0.62	1.3	1.4	1.2	1.3	0.72	**1.6**	**3**
Barium	28.3	580	19,000	1,500	2.1 J	10 J	14 J	15 J	6.1 J	4.8 J	13 J	26 J	23 J
Beryllium	0.332	63	200	16	0.022 J	0.083 J	0.089 J	0.071 J	0.032 J	0.023 J	0.071 J	0.14	0.22
Cadmium	0.208	3	80	7	0.046 U	0.02 J	0.0052 J	0.05 U	0.0041 J	0.0096 J	0.05 U	0.0039 J	0.069
Calcium	1,530	--	--	--	50 U	50 U	50 U	50 U	50 U	46 U	50 U	64	3,000
Chromium (hexavalent)	3.74	3.8	5.6	0.29	3.71 J-	3.25 J-	4.27 J-	4.45 J-	4.77 J-	**5.97 J-**	4.28 J-	3.8 J-	0.27 UJ
Chromium	27.6	3.8	5.6	0.29	4.6	**7.5**	**9.5**	**10**	**6.6**	**8.6**	**9.4**	**10**	**10**
Cobalt	1.36	0.9	30	2.3	0.26	0.32	0.5	0.54	0.24	0.25	0.43	0.49	0.73
Copper	6.05	700	4,100	310	0.52	0.16 J	0.48	0.55	0.41	0.57	0.34	1.3	3.3
Iron	12,700	150	72,000	5,500	1,700	1,200	4,400	4,100	4,300	4,900	4,100	6,900	7,500
Lead	11.2	270	800	400	2.4	5.2	5.8	6.2	4	3.1	5	5.9	18
Magnesium	776	--	--	--	68	240	360	360	170	110	300	340	340
Manganese	18.3	65	2,300	180	1.7	2.9	5	4.9	3.1	2.6	5	6.9	31
Mercury	0.0852	1	31	2.3	0.017 U	0.017 J	0.008 J	0.012 J	0.0098 J	0.014 J	0.011 J	0.017 J	0.033 J
Nickel	7.08	130	2,000	150	1.2	1.3	2.1	2.2	1	1.2	1.7	2	2.7
Potassium	620	--	--	--	79	230	250	260	170	110	220	260	410
Selenium	0.736	2.1	510	39	0.12 J	0.28 J	0.21 J	0.31 J	0.31 J	0.29 J	0.18 J	0.27 J	0.74
Silver	0.198	3.4	510	39	0.0092 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.0094 U	0.011 J
Sodium	--	--	--	--	25 U	25 U	25 U	25 U	25 U	23 U	25 U	23 U	93
Thallium	--	0.28	1	0.078	0.015 J	0.095 J	0.1	0.11	0.045 J	0.045 J	0.091 J	0.1	0.091 J
Vanadium	35.6	6	520	39	4.9	7.6	14	15	10	11	11	17	18
Zinc	14.1	1,200	31,000	2,300	1.6 J	3	4.7	5.8	2.5	5	3.9	4.3	44

Notes:

Shading indicates exceedance of the base background undeveloped combined concentration for subsurface soil

Bold box indicates exceedance of NC SSL

Bold text indicates exceedance of Adjusted Industrial Soil RSLs

Underline indicates exceedance of Adjusted Residential Soil RSLs

BTV - Background Threshold Values for MCIEAST-MCB CAMLEJ

RSLs were adjusted for noncarcinogens to account for exposure to multiple constituents

J - Analyte present, value may or may not be accurate or precise

J- - Analyte present, value may be biased low, actual value may be higher

U - The material was analyzed for, but not detected

UJ - Analyte not detected, quantitation limit may be inaccurate

mg/kg - Milligrams per kilogram

µg/kg - Micrograms per kilogram

TABLE 4-2

Subsurface Soil Analytical Data Exceedances

Site UXO-25 - Verona Loop PA/SI

MCIEAST-MCB CAMLEJ

North Carolina

Station ID	BTV (Undeveloped SB Combined Soil) (Aug 2011)	NC SSL (Feb 2012)	Adjusted Industrial Soil RSLs (May 2012)	Adjusted Residential Soil RSLs (May 2012)	VL-IS09	VL-IS10	VL-IS11	VL-IS12	VL-IS13	VL-IS14		VL-MW02	VL-IS16
Sample ID					VL-SB09-1-4-12B	VL-SB10-1-4-12B	VL-SB11-1-4-12B	VL-SB12-1-4-12B	VL-SB13-1-4-12B	VL-SB14-1-4-12B	VL-SB14D-1-4-12B	VL-SB15-1-6_5-12B	VL-SB16-1-5-12B
Sample Date					04/26/12	04/25/12	04/26/12	04/26/12	04/26/12	04/26/12	04/26/12	04/24/12	04/26/12
Chemical Name													
Explosives (µg/kg)													
No Detections													
Total Metals (mg/kg)													
Aluminum	19,000	--	99,000	7,700	8,000	13,000	13,000	18,000	8,500	15,000 J	11,000 J	5,200	11,000
Antimony	1.1	0.9	41	3.1	0.05 U	0.068 J	0.054 J	0.032 J	0.033 J	0.05 U	0.05 U	0.047 U	0.029 J
Arsenic	5.09	5.8	1.6	0.39	1.1	**2.3**	1.4	**2.9**	1.5	0.98 J	1.4 J	0.45 J	1.2
Barium	28.3	580	19,000	1,500	9.3 J	7.5 J	12 J	20 J	6.8 J	18 J	15 J	9.5 J	12 J
Beryllium	0.332	63	200	16	0.082 J	0.046 J	0.1	0.22	0.036 J	0.11	0.14	0.13	0.1
Cadmium	0.208	3	80	7	0.0086 J	0.05 U	0.0057 J	0.0074 J	0.05 U	0.0051 J	0.0056 J	0.01 J	0.0061 J
Calcium	1,530	--	--	--	190	50 U	50 U	110	21 J	140	130	72	31 J
Chromium (hexavalent)	3.74	3.8	5.6	0.29	1.36 J-	5.05 J-	**6.59 J-**	2.43 J-	3.78 J-	3.31 J-	3.3 J-	3.9 J-	4.55 J-
Chromium	27.6	3.8	5.6	0.29	**5.9**	**10**	**9.5**	**11**	**7.7**	**9.3**	**9.3**	5.3	**8.6**
Cobalt	1.36	0.9	30	2.3	0.25	0.46	0.37	0.53	0.36	0.38	0.31	0.14	0.3
Copper	6.05	700	4,100	310	0.6	1.2	0.26	0.44	1.2	0.27	0.24	0.48	0.22
Iron	12,700	150	72,000	5,500	3,300	9,300	10,000	4,400	2,700	2,400	2,000	1,000	3,600
Lead	11.2	270	800	400	5.9	4.4	4.9	7.9	5.1	6.7	6.8	4.1	5.8
Magnesium	776	--	--	--	170	270	320	450	200	410 J	270 J	150	280
Manganese	18.3	65	2,300	180	3.2	3.8	3.7	4.5	3.4	4.2	3.4	3.8	3.9
Mercury	0.0852	1	31	2.3	0.02 J	0.013 J	0.014 J	0.036 J	0.016 J	0.024 J	0.025 J	0.017 U	0.017 J
Nickel	7.08	130	2,000	150	1.3	2	1.5	2.9	1.7	1.6	1.3	0.57	1.1
Potassium	620	--	--	--	200	270	330	540	230	410	320	300	320
Selenium	0.736	2.1	510	39	0.34 J	0.39 J	0.29 J	0.55	0.2 J	0.34 J	0.51	0.16 J	0.38 J
Silver	0.198	3.4	510	39	0.0047 J	0.01 U	0.0047 J	0.0047 J	0.01 U	0.0083 J	0.0077 J	0.0058 J	0.0053 J
Sodium	--	--	--	--	19 J	25 U	17 J	25 J	6.6 J	22 J	18 J	25 U	18 J
Thallium	--	0.28	1	0.078	0.052 J	0.065 J	0.083 J	0.12	0.058 J	0.12	0.11	0.051 J	0.085 J
Vanadium	35.6	6	520	39	11	19	19	25	15	11	9	7.5	12
Zinc	14.1	1,200	31,000	2,300	4	2.8	2.3	5.4	6.4	4.9 J	3.3 J	2.1	3.2

Notes:

Shading indicates exceedance of the base background undeveloped combined concentration for subsurface soil

Bold box indicates exceedance of NC SSL

Bold text indicates exceedance of Adjusted Industrial Soil RSLs

Underline indicates exceedance of Adjusted Residential Soil RSLs

BTV - Background Threshold Values for MCIEAST-MCB CAMLEJ

RSLs were adjusted for noncarcinogens to account for exposure to multiple constituents

J - Analyte present, value may or may not be accurate or precise

J- - Analyte present, value may be biased low, actual value may be higher

U - The material was analyzed for, but not detected

UJ - Analyte not detected, quantitation limit may be inaccurate

mg/kg - Milligrams per kilogram

µg/kg - Micrograms per kilogram

TABLE 4-3

Groundwater Analytical Data Exceedances

Site UXO-25 - Verona Loop PA/SI

MCIEAST-MCB CAMLEJ

North Carolina

Station ID	NCGWQS (Feb 2012)	RSLs Tapwater Adjusted (May 2012)	MCIEAST-MCB CAMLEJ BTVs for Surficial Aquifer (Sept 2011)	VL-MW01	VL-MW02	
Sample ID				VL-GW01-12B	VL-GW02-12B	VL-GW02D-12B
Sample Date				04/26/12	04/26/12	04/26/12
Chemical Name						
Explosives (µg/l)						
No Detections						
Total Metals (µg/l)						
Aluminum	--	1,600	14,000	130	150	89 J
Arsenic	10	0.045	9.79	**0.26 J**	0.5 U	0.5 U
Barium	700	290	359	19	43	40
Beryllium	4	1.6	0.87	0.4 U	0.12 J	0.4 U
Cadmium	2	0.69	--	0.051 J	0.1 U	0.1 U
Calcium	--	--	179,000	3,400	2,300	2,100
Chromium	10	0.031	16.9	**0.22 J**	**0.47 J**	**0.24 J**
Cobalt	1	0.47	3.38	**0.56 J**	**1.3**	**1.2**
Copper	1,000	62	6.59	0.25 J	0.38 J	0.25 J
Iron	300	1,100	16,100	680	**1,100**	980
Lead	15	15	8.92	0.19 J	0.16 J	0.17 J
Magnesium	--	--	13,500	780	610	570
Manganese	50	32	176	18	**42**	**39**
Mercury	1	0.43	--	0.1 U	**0.46**	0.1 U
Nickel	100	30	11.8	0.99 J	2.6	2.3
Potassium	--	--	5,590	500	1,300	1,300
Selenium	20	7.8	--	1 U	1 U	0.63 J
Sodium	--	--	22,700	5,000	9,300	8,800
Vanadium	0.3	7.8	26.7	0.4 J	0.33 J	0.29 J
Zinc	1,000	470	41.2	10	20 J	35 J
Dissolved Metals (µg/l)						
Aluminum, Dissolved	--	1,600	--	31 J	50 U	50 U
Arsenic, Dissolved	10	0.045	--	0.5 U	**0.25 J**	0.5 U
Barium, Dissolved	700	290	--	20	36	32
Beryllium, Dissolved	4	1.6	--	0.4 U	0.4 U	0.12 J
Calcium, Dissolved	--	--	--	3,500	2,000	2,000
Chromium, Dissolved	10	0.031	--	**0.21 J**	0.5 U	0.5 U
Cobalt, Dissolved	1	0.47	--	**0.6 J**	**0.98 J**	**1**
Copper, Dissolved	1,000	62	--	0.5 U	0.34 J	0.79 J
Iron, Dissolved	300	1,100	--	630	**1,100**	**1,100**
Magnesium, Dissolved	--	--	--	810	560	590
Manganese, Dissolved	50	32	--	20	**32**	**33**
Mercury, Dissolved	1	0.43	--	0.1 U	0.19 J	0.1 U
Nickel, Dissolved	100	30	--	0.96 J	2	2.1
Potassium, Dissolved	--	--	--	530	1,200	1,300
Selenium, Dissolved	20	7.8	--	1.3 J	1 U	1.4 J
Sodium, Dissolved	--	--	--	5,100	8,800	9,100
Vanadium, Dissolved	0.3	7.8	--	0.38 J	0.15 J	0.14 J
Zinc, Dissolved	1,000	470	--	12 J	22 J	14 J

Notes:

Bold box indicates exceedance of NCGWQS or the more conservative MCL

Bold text indicates exceedance of Adjusted Tap Water RSLs

Shading indicates exceedance of MCIEAST-MCB CAMLEJ BTVs for Surficial Aquifer

RSLs were adjusted for noncarcinogens to account for exposure to multiple constituents

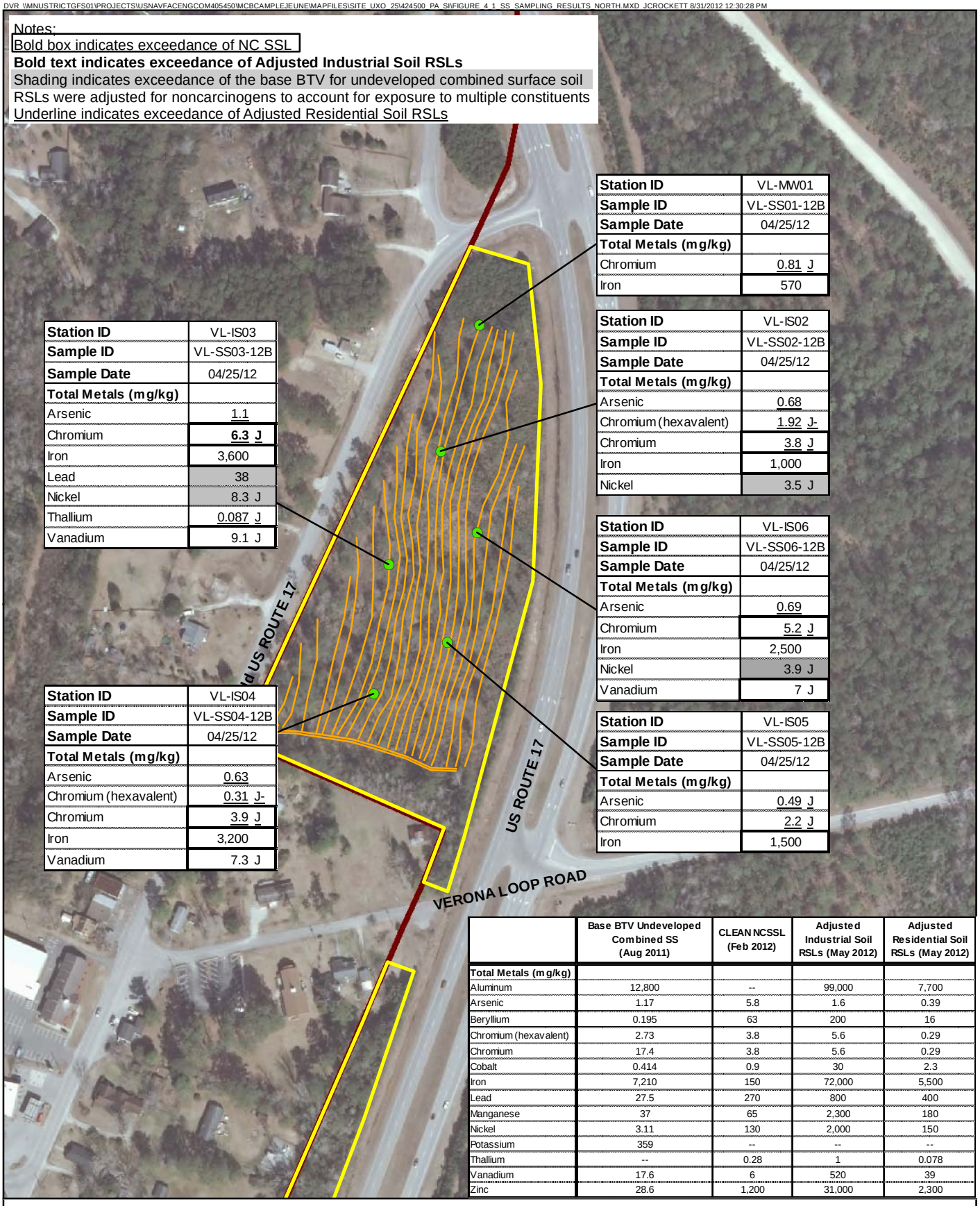
BTV - Background Threshold Values for MCIEAST-MCB CAMLEJ

J - Analyte present, value may or may not be accurate or precise

U - The material was analyzed for, but not detected

UJ - Analyte not detected, quantitation limit may be inaccurate

µg/l - Micrograms per liter



Station ID	VL-IS03
Sample ID	VL-SS03-12B
Sample Date	04/25/12
Total Metals (mg/kg)	
Arsenic	1.1
Chromium	**6.3 J**
Iron	3,600
Lead	38
Nickel	8.3 J
Thallium	0.087 J
Vanadium	9.1 J

Station ID	VL-MW01
Sample ID	VL-SS01-12B
Sample Date	04/25/12
Total Metals (mg/kg)	
Chromium	0.81 J
Iron	570

Station ID	VL-IS02
Sample ID	VL-SS02-12B
Sample Date	04/25/12
Total Metals (mg/kg)	
Arsenic	0.68
Chromium (hexavalent)	1.92 J-
Chromium	3.8 J
Iron	1,000
Nickel	3.5 J

Station ID	VL-IS06
Sample ID	VL-SS06-12B
Sample Date	04/25/12
Total Metals (mg/kg)	
Arsenic	0.69
Chromium	5.2 J
Iron	2,500
Nickel	3.9 J
Vanadium	7 J

Station ID	VL-IS04
Sample ID	VL-SS04-12B
Sample Date	04/25/12
Total Metals (mg/kg)	
Arsenic	0.63
Chromium (hexavalent)	0.31 J-
Chromium	3.9 J
Iron	3,200
Vanadium	7.3 J

Station ID	VL-IS05
Sample ID	VL-SS05-12B
Sample Date	04/25/12
Total Metals (mg/kg)	
Arsenic	0.49 J
Chromium	2.2 J
Iron	1,500

	Base BTV Undeveloped Combined SS (Aug 2011)	CLEAN NCSSL (Feb 2012)	Adjusted Industrial Soil RSLs (May 2012)	Adjusted Residential Soil RSLs (May 2012)
Total Metals (mg/kg)				
Aluminum	12,800	--	99,000	7,700
Arsenic	1.17	5.8	1.6	0.39
Beryllium	0.195	63	200	16
Chromium (hexavalent)	2.73	3.8	5.6	0.29
Chromium	17.4	3.8	5.6	0.29
Cobalt	0.414	0.9	30	2.3
Iron	7,210	150	72,000	5,500
Lead	27.5	270	800	400
Manganese	37	65	2,300	180
Nickel	3.11	130	2,000	150
Potassium	359	--	--	--
Thallium	--	0.28	1	0.078
Vanadium	17.6	6	520	39
Zinc	28.6	1,200	31,000	2,300

Legend
- Surface Soil Sampling Locations
- DGM Transects
- UXO-25 - Verona Loop
- Installation Boundary

Notes:
BTV - Background Threshold Values for MCIEAST-MCB CAMLEJ
J - Analyte present, value may or may not be accurate or precise
J- - Analyte present, value may be biased low, actual value may be higher
mg/kg - Milligrams per kilogram
RSL – Regional Screening Level
NC SSL – North Carolina Soil Screening Level

N

0 125 250 Feet

1 inch = 250 feet

Figure 4-1
Surface Soil Sampling Results - North
Site UXO-25 - Verona Loop PA/SI
MCIEAST-MCB CAMLEJ
North Carolina

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Notes;
Bold box indicates exceedance of NC SSL
Bold text indicates exceedance of Adjusted Industrial Soil RSLs
Shading indicates exceedance of the base BTV for undeveloped combined surface soil
RSLs were adjusted for noncarcinogens to account for exposure to multiple constituents
Underline indicates exceedance of Adjusted Residential Soil RSLs

Station ID	VL-IS09
Sample ID	VL-SS09-12B
Sample Date	04/26/12
Total Metals (mg/kg)	
Arsenic	1.2
Chromium	**5.6 J**
Iron	3,000
Vanadium	9.7 J

Station ID	VL-IS11
Sample ID	VL-SS11-12B
Sample Date	04/26/12
Total Metals (mg/kg)	
Arsenic	0.75
Chromium (hexavalent)	0.5 J-
Chromium	5.5 J
Iron	1,600
Vanadium	8 J

Station ID	VL-IS13
Sample ID	VL-SS13-12B
Sample Date	04/26/12
Total Metals (mg/kg)	
Arsenic	**1.6**
Chromium (hexavalent)	0.58 J-
Chromium	**6.5 J**
Iron	3,600
Vanadium	12 J

Station ID	VL-IS16
Sample ID	VL-SS16-12B
Sample Date	04/26/12
Total Metals (mg/kg)	
Aluminum	9,700
Arsenic	0.93
Chromium (hexavalent)	0.97 J-
Chromium	**6.4 J**
Iron	2,200
Nickel	4.3 J
Vanadium	8.3 J

Station ID	VL-MW02
Sample ID	VL-SS15-12B
Sample Date	04/25/12
Total Metals (mg/kg)	
Arsenic	0.47 J
Chromium	1.9 J
Iron	740

Station ID	VL-IS14
Sample ID	VL-SS14-12B
Sample Date	04/26/12
Total Metals (mg/kg)	
Aluminum	18,000
Arsenic	**2.1**
Beryllium	0.32
Chromium	**12 J**
Cobalt	0.73
Iron	4,700
Lead	56
Nickel	4.9 J
Potassium	420
Thallium	0.11
Vanadium	16 J

Station ID	VL-IS07
Sample ID	VL-SS07-12B
Sample Date	04/25/12
Total Metals (mg/kg)	
Arsenic	0.57
Chromium (hexavalent)	0.29 J-
Chromium	2.8 J
Iron	2,000

Station ID	VL-IS08
Sample ID	VL-SS08-12B
Sample Date	04/25/12
Total Metals (mg/kg)	
Aluminum	15,000
Arsenic	**6.9**
Beryllium	0.37
Chromium	**16 J**
Cobalt	1.6
Iron	9,000
Lead	42
Manganese	79
Nickel	4.6 J
Potassium	470
Thallium	0.13
Vanadium	29 J
Zinc	120

Station ID	VL-IS10
Sample ID	VL-SS10-12B
Sample Date	04/25/12
Total Metals (mg/kg)	
Chromium	0.96 J
Iron	880

Station ID	VL-IS12
Sample ID	VL-SS12-12B
Sample Date	04/26/12
Total Metals (mg/kg)	
Aluminum	16,000
Arsenic	**2.2**
Beryllium	0.3
Chromium (hexavalent)	0.41 J-
Chromium	**12 J**
Cobalt	0.56
Iron	4,300
Potassium	440
Thallium	0.13
Vanadium	19 J

	Base BTV Undeveloped Combined SS (Aug 2011)	CLEAN NCSSL (Feb 2012)	Adjusted Industrial Soil RSLs (May 2012)	Adjusted Residential Soil RSLs (May 2012)
Total Metals (mg/kg)				
Aluminum	12,800	--	99,000	7,700
Arsenic	1.17	5.8	1.6	0.39
Beryllium	0.195	63	200	16
Chromium (hexavalent)	2.73	3.8	5.6	0.29
Chromium	17.4	3.8	5.6	0.29
Cobalt	0.414	0.9	30	2.3
Iron	7,210	150	72,000	5,500
Lead	27.5	270	800	400
Manganese	37	65	2,300	180
Nickel	3.11	130	2,000	150
Potassium	359	--	--	--
Thallium	--	0.28	1	0.078
Vanadium	17.6	6	520	39
Zinc	28.6	1,200	31,000	2,300

Legend
- Surface Soil Sampling Locations
- DGM Transects
- UXO-25 - Verona Loop
- Installation Boundary

Notes:
BTV - Background Threshold Values for MCIEAST-MCB CAMLEJ
J - Analyte present, value may or may not be accurate or precise
J- - Analyte present, value may be biased low actual value may be higher
mg/kg - Milligrams per kilogram
RSL – Regional Screening Level
NC SSL – North Carolina Soil Screening Level

N

0 125 250 Feet

1 inch = 250 feet

Figure 4-2
Surface Soil Sampling Results - South
Site UXO-25 - Verona Loop PA/SI
MCIEAST-MCB CAMLEJ
North Carolina

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DVR \\MNUSTRICTGFS01\PROJECTS\USNAVFACENGCOM405450\MCBCAMPLEJEUNE\MAPFILES\SITE_UXO_25\424500_PA_SI\FIGURE_4_3_SB_SAMPLING_RESULTS_NORTH.MXD JCROCKETT 8/31/2012 12:34:34 PM

	Base BTV Undeveloped Combined SB (Aug 2011)	CLEAN NCSSL (Feb 2012)	Adjusted Industrial Soil RSLs (May 2012)	Adjusted Residential Soil RSLs (May 2012)
Total Metals (mg/kg)				
Aluminum	19,000	--	99,000	7,700
Arsenic	5.09	5.8	1.6	0.39
Calcium	1,530	--	--	--
Chromium (hexavalent)	3.74	3.8	5.6	0.29
Chromium	27.6	3.8	5.6	0.29
Iron	12,700	150	72,000	5,500
Lead	11.2	270	800	400
Manganese	18.3	65	2,300	180
Selenium	0.736	2.1	510	39
Thallium	--	0.28	1	0.078
Vanadium	35.6	6	520	39
Zinc	14.1	1,200	31,000	2,300

Station ID	VL-MW01
Sample ID	VL-SB01-1-6-12B
Sample Date	04/24/12
Total Metals (mg/kg)	
Arsenic	0.57
Chromium (hexavalent)	3.71 J-
Chromium	4.6
Iron	1,700

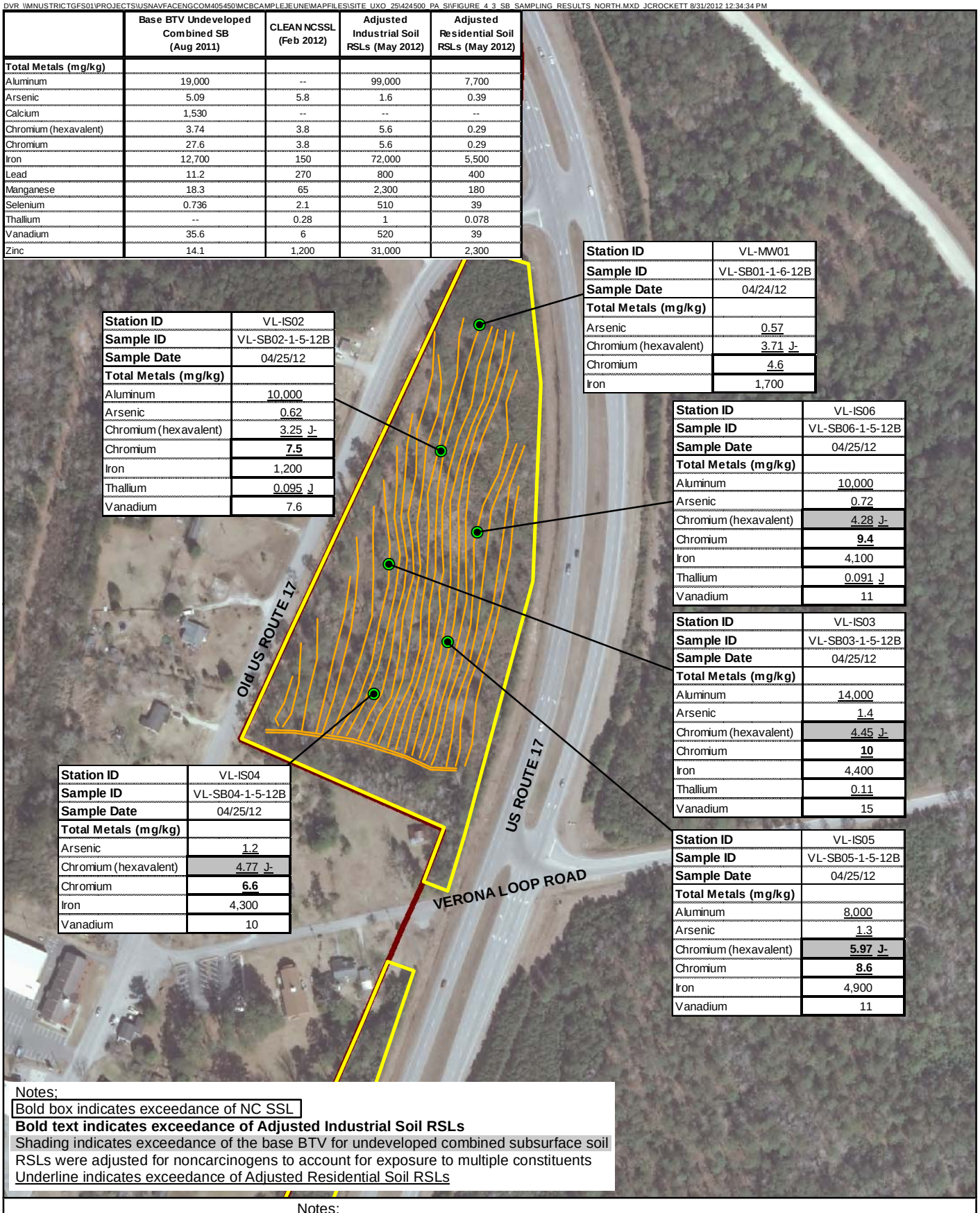
Station ID	VL-IS02
Sample ID	VL-SB02-1-5-12B
Sample Date	04/25/12
Total Metals (mg/kg)	
Aluminum	10,000
Arsenic	0.62
Chromium (hexavalent)	3.25 J-
Chromium	**7.5**
Iron	1,200
Thallium	0.095 J
Vanadium	7.6

Station ID	VL-IS06
Sample ID	VL-SB06-1-5-12B
Sample Date	04/25/12
Total Metals (mg/kg)	
Aluminum	10,000
Arsenic	0.72
Chromium (hexavalent)	4.28 J-
Chromium	**9.4**
Iron	4,100
Thallium	0.091 J
Vanadium	11

Station ID	VL-IS03
Sample ID	VL-SB03-1-5-12B
Sample Date	04/25/12
Total Metals (mg/kg)	
Aluminum	14,000
Arsenic	1.4
Chromium (hexavalent)	4.45 J-
Chromium	**10**
Iron	4,400
Thallium	0.11
Vanadium	15

Station ID	VL-IS04
Sample ID	VL-SB04-1-5-12B
Sample Date	04/25/12
Total Metals (mg/kg)	
Arsenic	1.2
Chromium (hexavalent)	4.77 J-
Chromium	**6.6**
Iron	4,300
Vanadium	10

Station ID	VL-IS05
Sample ID	VL-SB05-1-5-12B
Sample Date	04/25/12
Total Metals (mg/kg)	
Aluminum	8,000
Arsenic	1.3
Chromium (hexavalent)	**5.97 J-**
Chromium	**8.6**
Iron	4,900
Vanadium	11



Notes;
Bold box indicates exceedance of NC SSL
Bold text indicates exceedance of Adjusted Industrial Soil RSLs
Shading indicates exceedance of the base BTV for undeveloped combined subsurface soil
RSLs were adjusted for noncarcinogens to account for exposure to multiple constituents
Underline indicates exceedance of Adjusted Residential Soil RSLs

Legend
- Subsurface Soil Sampling Locations
- DGM Transects
- UXO-25 - Verona Loop
- Installation Boundary

Notes:
BTV - Background Threshold Values for MCIEAST-MCB CAMLEJ
J - Analyte present, value may or may not be accurate or precise
J- - Analyte present, value may be biased low actual value may be higher
mk/kg - Milligrams per kilogram
RSL – Regional Screening Level
NC SSL – North Carolina Soil Screening Level

N

0 125 250
Feet

1 inch = 250 feet

Figure 4-3
Subsurface Soil Sampling Results - North
Site UXO-25 - Verona Loop PA/SI
MCIEAST-MCB CAMLEJ
North Carolina

CH2MHILL

	Base BTV Undeveloped Combined SB (Aug 2011)	CLEAN NCSSL (Feb 2012)	Adjusted Industrial Soil RSLs (May 2012)	Adjusted Residential Soil RSLs (May 2012)
Total Metals (mg/kg)				
Aluminum	19,000	--	99,000	7,700
Arsenic	5.09	5.8	1.6	0.39
Calcium	1,530	--	--	--
Chromium (hexavalent)	3.74	3.8	5.6	0.29
Chromium	27.6	3.8	5.6	0.29
Iron	12,700	150	72,000	5,500
Lead	11.2	270	800	400
Manganese	18.3	65	2,300	180
Selenium	0.736	2.1	510	39
Thallium	--	0.28	1	0.078
Vanadium	35.6	6	520	39
Zinc	14.1	1,200	31,000	2,300

Station ID	VL-IS07
Sample ID	VL-SB07-1-4-12B
Sample Date	04/25/12
Total Metals (mg/kg)	
Aluminum	11,000
Arsenic	**1.6**
Chromium (hexavalent)	3.8 J-
Chromium	**10**
Iron	6,900
Thallium	0.1
Vanadium	17

Station ID	VL-IS08
Sample ID	VL-SB08-1-4-12B
Sample Date	04/25/12
Total Metals (mg/kg)	
Aluminum	13,000
Arsenic	**3**
Calcium	3,000
Chromium	**10**
Iron	7,500
Lead	18
Manganese	31
Selenium	0.74
Thallium	0.091 J
Vanadium	18
Zinc	44

Station ID	VL-IS09
Sample ID	VL-SB09-1-4-12B
Sample Date	04/26/12
Total Metals (mg/kg)	
Aluminum	8,000
Arsenic	1.1
Chromium (hexavalent)	1.36 J-
Chromium	**5.9**
Iron	3,300
Vanadium	11

Station ID	VL-IS10
Sample ID	VL-SB10-1-4-12B
Sample Date	04/25/12
Total Metals (mg/kg)	
Aluminum	13,000
Arsenic	**2.3**
Chromium (hexavalent)	5.05 J-
Chromium	**10**
Iron	9,300
Vanadium	19

Station ID	VL-IS11
Sample ID	VL-SB11-1-4-12B
Sample Date	04/26/12
Total Metals (mg/kg)	
Aluminum	13,000
Arsenic	1.4
Chromium (hexavalent)	**6.59 J-**
Chromium	**9.5**
Iron	10,000
Thallium	0.083 J
Vanadium	19

Station ID	VL-IS12
Sample ID	VL-SB12-1-4-12B
Sample Date	04/26/12
Total Metals (mg/kg)	
Aluminum	18,000
Arsenic	**2.9**
Chromium (hexavalent)	2.43 J-
Chromium	**11**
Iron	4,400
Thallium	0.12
Vanadium	25

Station ID	VL-IS13
Sample ID	VL-SB13-1-4-12B
Sample Date	04/26/12
Total Metals (mg/kg)	
Aluminum	8,500
Arsenic	1.5
Chromium (hexavalent)	3.78 J-
Chromium	**7.7**
Iron	2,700
Vanadium	15

Station ID	VL-IS14
Sample ID	VL-SB14-1-4-12B
Sample Date	04/26/12
Total Metals (mg/kg)	
Aluminum	15,000 J
Arsenic	1.4 J
Chromium (hexavalent)	3.31 J-
Chromium	**9.3**
Iron	2,400
Thallium	0.12
Vanadium	11

Station ID	VL-IS16
Sample ID	VL-SB16-1-5-12B
Sample Date	04/26/12
Total Metals (mg/kg)	
Aluminum	11,000
Arsenic	1.2
Chromium (hexavalent)	4.55 J-
Chromium	**8.6**
Thallium	0.085 J
Vanadium	12

Station ID	VL-MW02
Sample ID	VL-SB15-1-6_5-12B
Sample Date	04/24/12
Total Metals (mg/kg)	
Arsenic	0.45 J
Chromium (hexavalent)	3.9 J-
Chromium	5.3
Iron	1,000
Vanadium	7.5

Old US ROUTE 17

US ROUTE 17

Notes;
Bold box indicates exceedance of NC SSL
Bold text indicates exceedance of Adjusted Industrial Soil RSLs
Shading indicates exceedance of the base BTV for undeveloped combined subsurface soil
RSLs were adjusted for noncarcinogens to account for exposure to multiple constituents
Underline indicates exceedance of Adjusted Residential Soil RSLs

Legend
- Subsurface Soil Sampling Locations
- DGM Transects
- UXO-25 - Verona Loop
- Installation Boundary

Notes:
BTV - Background Threshold Values for MCIEAST-MCB CAMLEJ
J - Analyte present, value may or may not be accurate or precise
J- - Analyte present, value may be biased low actual value may be higher
mg/kg - Milligrams per kilogram
RSL – Regional Screening Level
NC SSL – North Carolina Soil Screening Level

N

0 125 250 Feet

1 inch = 250 feet

Figure 4-4
Subsurface Soil Sampling Results - South
Site UXO-25 - Verona Loop PA/SI
MCIEAST-MCB CAMLEJ
North Carolina

CH2MHILL

	NCGWQS (Feb. 2012)	CLEAN RSLs Tapwater Adjusted 0512	MCIEAST-MCB CAMLEJ BTVs for Surficial Aquifer (Sept. 2011)
Total Metals (µg/l)			
Arsenic	10	0.045	9.79
Chromium	10	0.031	16.9
Cobalt	1	0.47	3.38
Iron	300	1,100	16,100
Manganese	50	32	176
Mercury	1	0.43	--
Vanadium	0.3	7.8	26.7
Dissolved Metals (µg/l)			
Arsenic, Dissolved	10	0.045	--
Chromium, Dissolved	10	0.031	--
Cobalt, Dissolved	1	0.47	--
Iron, Dissolved	300	1,100	--
Manganese, Dissolved	50	32	--
Vanadium, Dissolved	0.3	7.8	--

Station ID	VL-MW01
Sample ID	VL-GW01-12B
Sample Date	04/26/12
Total Metals (µg/l)	
Arsenic	**0.26 J**
Chromium	**0.22 J**
Cobalt	**0.56 J**
Iron	680
Vanadium	0.4 J
Dissolved Metals (µg/l)	
Chromium, Dissolved	**0.21 J**
Cobalt, Dissolved	**0.6 J**
Iron, Dissolved	630
Vanadium, Dissolved	0.38 J

Old US ROUTE 17

US ROUTE 17

VERONA LOOP ROAD

Notes:
Bold box indicates exceedance of NCGWQS or the more conservative MCL
Bold text indicates exceedance of Adjusted Tap Water RSLs
Shading indicates exceedance of MCIEAST-MCB CAMLEJ BTVs for Surficial Aquifer
RSLs were adjusted for noncarcinogens to account for exposure to multiple constituents

Legend
- Groundwater Sampling Locations
- DGM Transects
- UXO-25 - Verona Loop
- Installation Boundary

Notes:
BTV - Background Threshold Values for MCIEAST-MCB CAMLEJ
J - Analyte present, value may or may not be accurate or precise
µg/kg - Micrograms per kilogram
RSL – Regional Screening Level

N

0 125 250
Feet

1 inch = 250 feet

Figure 4-5
Groundwater Sampling Results - North
Site UXO-25 - Verona Loop PA/SI
MCIEAST-MCB CAMLEJ
North Carolina

CH2MHILL

	NCGWQS (Feb. 2012)	CLEAN RSLs Tapwater Adjusted 0512	MCIEAST-MCB CAMLEJ BTVs for Surficial Aquifer (Sept. 2011)
Total Metals (µg/l)			
Arsenic	10	0.045	9.79
Chromium	10	0.031	16.9
Cobalt	1	0.47	3.38
Iron	300	1,100	16,100
Manganese	50	32	176
Mercury	1	0.43	--
Vanadium	0.3	7.8	26.7
Dissolved Metals (µg/l)			
Arsenic, Dissolved	10	0.045	--
Chromium, Dissolved	10	0.031	--
Cobalt, Dissolved	1	0.47	--
Iron, Dissolved	300	1,100	--
Manganese, Dissolved	50	32	--
Vanadium, Dissolved	0.3	7.8	--

Station ID	VL-MW02
Sample ID	VL-GW02-12B
Sample Date	04/26/12
Total Metals (µg/l)	
Chromium	**0.47 J**
Cobalt	**1.3**
Iron	**1,100**
Manganese	**42**
Mercury	**0.46**
Vanadium	0.33 J
Dissolved Metals (µg/l)	
Arsenic, Dissolved	**0.25 J**
Cobalt, Dissolved	**1**
Iron, Dissolved	**1,100**
Manganese, Dissolved	**33**

Old US ROUTE 17

US ROUTE 17

Notes:
Bold box indicates exceedance of NCGWQS or the more conservative MCL
Bold text indicates exceedance of Adjusted Tap Water RSLs
Shading indicates exceedance of MCIEAST-MCB CAMLEJ BTVs for Surficial Aquifer
RSLs were adjusted for noncarcinogens to account for exposure to multiple constituents

Legend
- Groundwater Sampling Locations
- DGM Transects
- UXO-25 - Verona Loop
- Installation Boundary

Notes:
BTV - Background Threshold Values for MCIEAST-MCB CAMLEJ
J - Analyte present, value may or may not be accurate or precise
µg/kg - Micrograms per kilogram
RSL – Regional Screening Level

N

0 125 250
Feet

1 inch = 250 feet

Figure 4-6
Groundwater Sampling Results - South
Site UXO-25 - Verona Loop PA/SI
MCIEAST-MCB CAMLEJ
North Carolina

CH2MHILL

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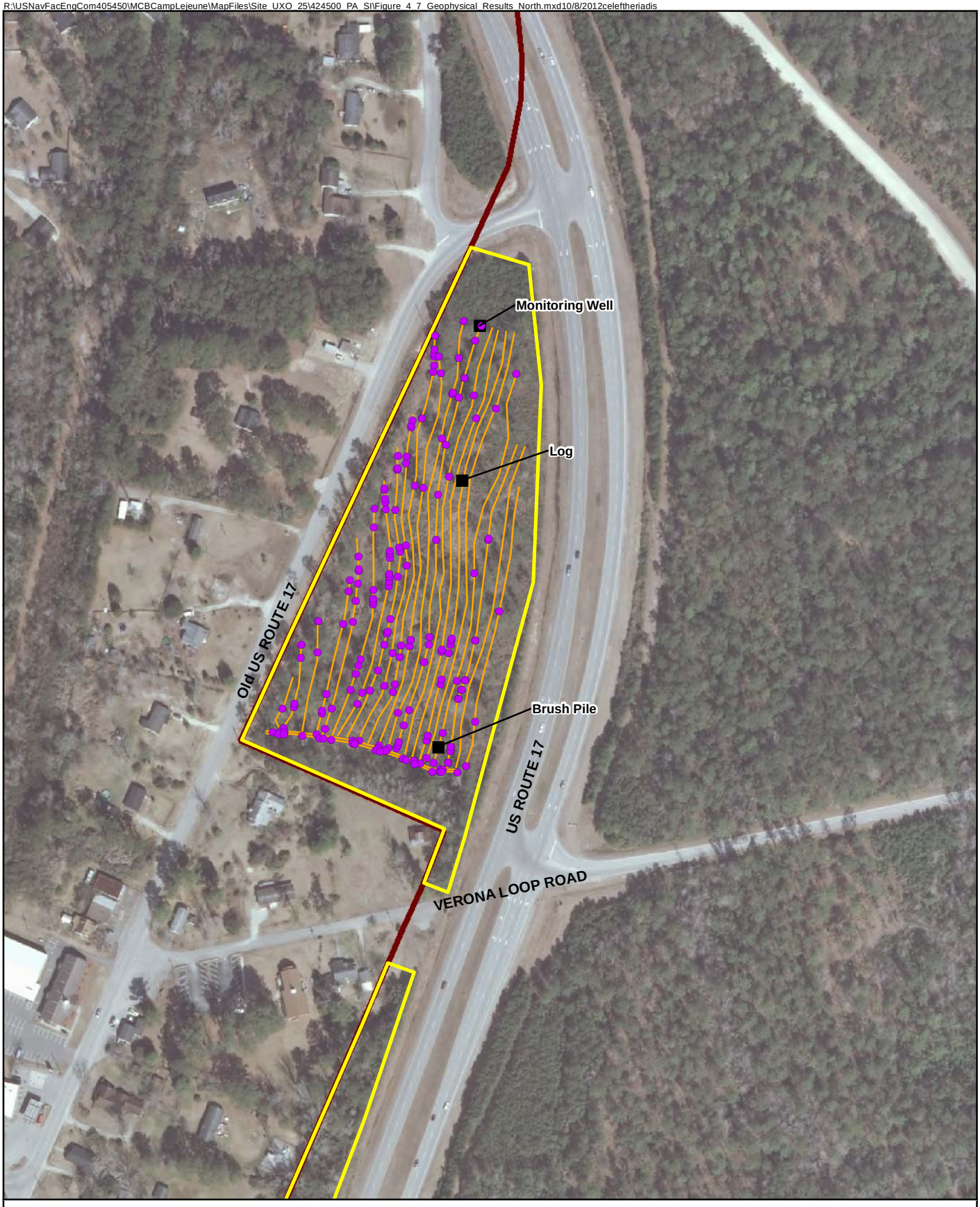

Legend

- Selected Targets
- Cultural Features
- DGM Transects
- UXO-25 - Verona Loop
- Installation Boundary

N

0 125 250 Feet

1 inch = 250 feet

Figure 4-7
Geophysical Results - North
Site UXO-25 - Verona Loop PA/SI
MCIEAST-MCB CAMLEJ
North Carolina

CH2MHILL

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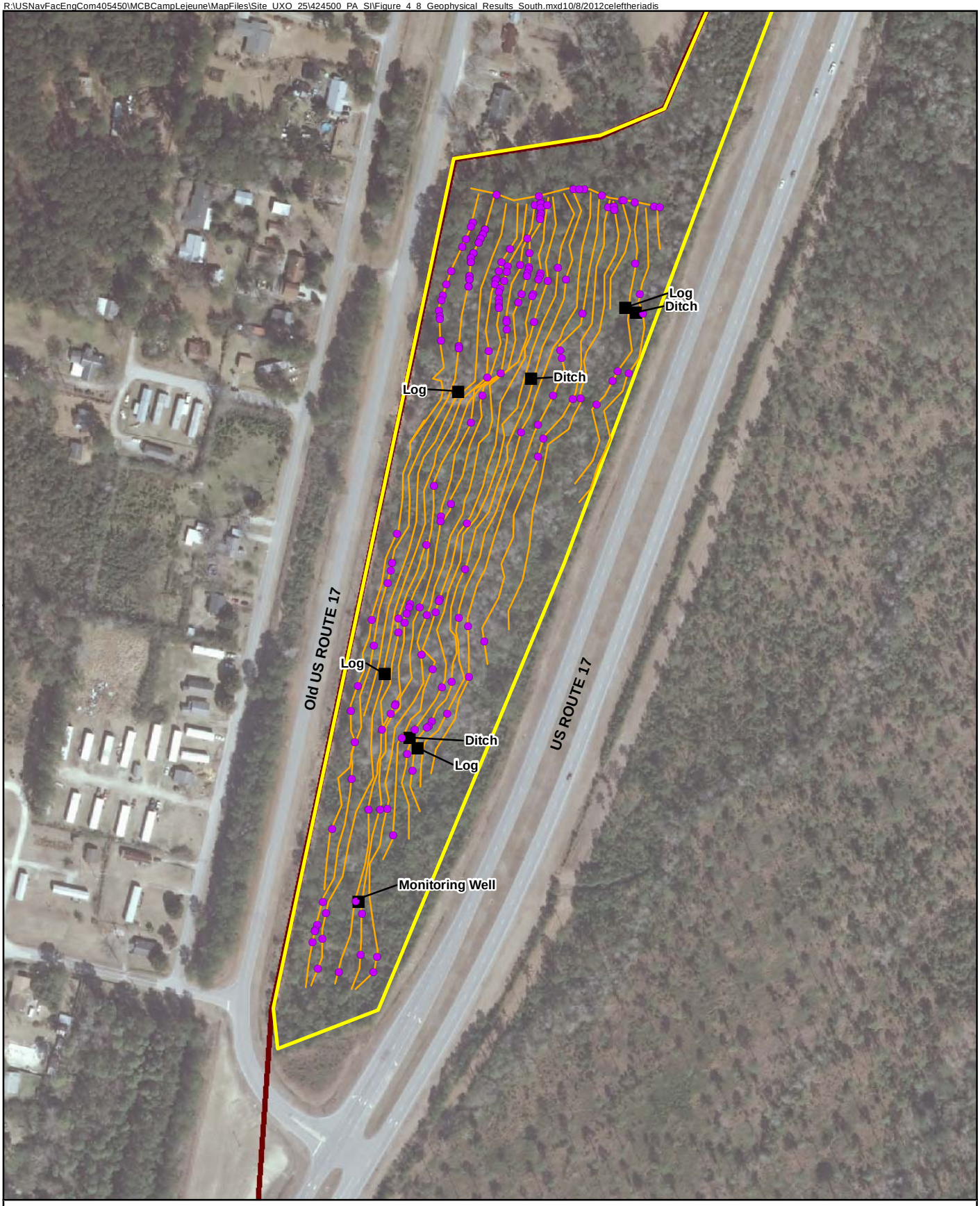

Legend

- Selected Targets
- Cultural Features
- DGM Transects
- UXO-25 - Verona Loop
- Installation Boundary

N

0 125 250

Feet

1 inch = 250 feet

Figure 4-8
Geophysical Results - South
Site UXO-25 - Verona Loop PA/SI
MCIEAST-MCB CAMLEJ
North Carolina

CH2MHILL

SECTION 5

Human Health Risk Screening

A conservative human health risk screening (HHRS) was performed to assess the potential for human health risks associated with exposure to groundwater and soil at UXO-25. The results of the HHRS provide a preliminary indication of potential risks from chemicals of potential concern (COPCs), and are used to help evaluate whether future unrestricted (i.e., residential) use of the site is acceptable or if the site requires further evaluation (e.g., additional data collection, a baseline risk assessment). The HHRS was performed in a phased approach, as described below. All HHRS results are included in **Appendix F**.

The validated laboratory analytical data used in the HHRS included the surface and subsurface soil and groundwater samples collected in April 2012, as discussed in Section 4.1. A review of the data identified the following criteria for data usability:

- Estimated values flagged with a J qualifier were treated as detected concentrations
- For duplicate samples, the maximum concentration between the two samples was used as the sample concentration

5.1 Methodology

The HHRS was conducted in three steps using a risk ratio technique (Navy, 2000). COPCs identified in Step 1 were evaluated in Step 2. If COPCs were identified in Step 2, they were evaluated in Step 3. The three-step screening process is described below.

5.1.1 Step 1

The maximum detected concentrations for each medium were compared to the USEPA risk based RSLs (USEPA, 2012), other human health risk screening levels (if appropriate), and the MCIEAST-MCBCAMLEJ BTVs (CH2M HILL, 2011c and d). RSLs based on non-carcinogenic effects were divided by 10 to account for exposure to multiple constituents (i.e., were adjusted to a hazard quotient [HQ] of 0.1, from the HQ of 1 used in the RSL table). RSLs based on carcinogenic endpoints were used as presented in the RSL table, and are based on a carcinogenic risk of 1×10^{-6}.

The soil data were compared to residential soil RSLs. Residential soil RSLs are more conservative (i.e., lower) than industrial soil RSLs and are therefore protective of all potential receptors (e.g., military personnel, trespassers/visitors, residents, industrial workers, construction workers). The soil data were also compared to the BTVs for combined soil types in undeveloped areas (CH2M HILL, 2011c). The NC SSLs (NCDENR, 2011) are shown on the Step 1 soil screening tables; however, they were not used to identify COPCs.

The groundwater data were compared to tap water RSLs and the BTV for surficial aquifer groundwater concentrations (CH2M HILL, 2011d). Lead concentrations in groundwater were compared to the lead federal action level for drinking water of 15 micrograms per liter (µg/L) (USEPA, 2009). Groundwater data were also compared to the maximum contaminant levels (MCLs) (USEPA, 2009) and the NCGWQS (NCDENR, 2010); however, these comparisons were not used to identify the groundwater COPCs to carry forward to Step 2.

If the maximum detected concentration of a constituent in groundwater or soil exceeded the applicable screening value and BTV, the screening level risk evaluation proceeded to Step 2.

In addition to comparing the detected concentrations to the screening levels, the detection limits for non-detected analytes were compared to the screening levels. Non-detected analytes with detection limits exceeding the screening level were not identified as COPCs to carry forward to Step 2, but are discussed below to evaluate the potential for underestimating the total risks.

5.1.2 Step 2

For analytes identified as COPCs in Step 1, a corresponding risk level was calculated using the following equation:

$$corresponding\ risk\ level = \frac{concentration \times acceptable\ risk\ level}{RSL}$$

The concentration is the maximum detected concentration (the same concentration that was used in Step 1). The acceptable risk level is 1 for non-carcinogens and 10^{-6} for carcinogens. RSLs for noncarcinogenic effects were not adjusted by 10 as was done in Step 1; they are used as presented in the RSL table.

The corresponding risk levels for each analyte were summed to calculate the cumulative corresponding hazard index (HI) (for non-carcinogens) and cumulative corresponding carcinogenic risk (for carcinogens). A cumulative corresponding HI was also calculated for each target organ/effect. If the cumulative corresponding HI for a target organ/effect is greater than 0.5, or the cumulative corresponding carcinogenic risk is greater than 5×10^{-5}, the analytes contributing to these values are retained as COPCs and further evaluation of the site may be necessary. For this HHRS, no COPCs were retained for Step 3 evaluation.

5.2 Human Health Risk Screening Results

Surface Soil

Tables F-1 and F-1a show the risk-based screening and risk ratio evaluation for surface soil. As shown in Table F-1, aluminum, arsenic and thallium were identified as COPCs for evaluation in Step 2. Based on Step 2 (risk ratio using maximum detected concentrations, Table F-1a) there were no analytes detected in surface soil at concentrations exceeding target risk levels. Therefore, exposure to surface soil would not result in any unacceptable human health risks, and no further evaluation of surface soil required based on potential human exposure.

Subsurface Soil

Tables F-2 and F-2a show the risk-based screening and risk ratio evaluation for subsurface soil. As shown in Table F-2, hexavalent chromium and thallium were identified as COPCs for evaluation in Step 2. Based on Step 2 (risk ratio using maximum detected concentrations, Table F-2a) there were no analytes detected in subsurface soil at concentrations exceeding target risk level. Therefore, exposure to subsurface soil would not result in any unacceptable human health risks, and no further evaluation of subsurface soil required based on potential human exposure.

Groundwater

Tables F-3 and F-3a show the risk-based screening and risk ratio evaluation for groundwater. As shown in Table F-3, mercury was identified as a COPC for evaluation in Step 2. Based on Step 2 (risk ratio using maximum detected concentrations, Table F-3a) mercury was eliminated as a COPC in groundwater at UXO-25. Therefore, exposure to groundwater would not result in any unacceptable human health risks, and no further evaluation of groundwater required based on potential human exposure.

5.2.1 Non-detected analytes

For surface and subsurface soil, four explosives that were not detected had detection limits that exceeded screening values; however, the detection limits were within an order of magnitude of the screening level.

There were 13 explosives and 3 metals not detected in groundwater with detection limits that exceeded screening level. All of the explosives have detection limits within an order of magnitude of the screening value. Of the three metals not detected in groundwater with detection limits that exceeded screening levels, two, (antimony and thallium) have detection limits within an order of magnitude of the screening level, background level, or MCL. Hexavalent chromium is the other metal not detected in groundwater with detection limits that exceed the screening level.

5.3 Human Health Risk Screening Summary

The human health risk based screening indicates that exposure to surface soil, subsurface soil, or groundwater at UXO-25 would not result in any COPCs, or unacceptable risks to human health.

SECTION 6

Ecological Risk Screening

This section presents the ecological risk screening for UXO-25.

6.1 Site Ecological Setting and Available Data

Site UXO-25 is predominately forested. Dominant species include Loblolly pine (*Pinus taeda*) and sweet gum (*Liquidambar styraciflua*). A drainage ditch intersects the southern portion of the site. The ditch drains to a culvert that extends beneath U.S. Route 17 and discharges into Mill Run Creek located immediately east of the highway, as shown on Figure G-1 of **Appendix G**. The drainage ditch is incised and, based on observations during site visits, appears to have been dredged. No additional water bodies or wetlands are present on the site. However, wetlands are located immediately west of U.S. Route 17 and the site. While groundwater likely flows east toward Mill Run Creek based on the topography of the area, shown on Figure G-2 included in **Appendix G**, insufficient data were collected at the site to be able to confirm. The ecological checklist in **Appendix G** identifies the terrestrial and aquatic habitats onsite.

The ERS evaluated all analytical data collected for the environmental investigation, as discussed in Section 4.1. The validated laboratory analytical data for each media are presented in Tables G-1 through G-3 in **Appendix G**.

6.2 Screening Methodology

For each medium (surface soil, subsurface soil, and groundwater), maximum and arithmetic mean concentrations of chemicals (i.e., exposure concentrations) were compared to Ecological Screening Values (ESVs) intended to be protective of ecological receptors. Hazard quotients were calculated by dividing the exposure concentrations by the ESVs. It should be noted that ESVs for metals in water are generally based on dissolved concentrations. As a result, comparing them to total metals concentrations is conservative and may overestimate risk.

The arithmetic mean was calculated using detected concentrations and one-half of the reporting limits for non-detected samples. For duplicate samples, the higher concentration was selected.

For soil, the USEPA Ecological Soil Screening Levels (EcoSSL) (USEPA, 2011a) were preferentially selected over USEPA Region 4 values (USEPA, 2001). When no EcoSSL was available for a constituent, the USEPA Region 4 value was selected.

A selection hierarchy was also applied to groundwater. The National Recommended Water Quality Criteria (NRWQC; USEPA, 2011b) were preferentially selected over the USEPA Region 4 values. However, when no NRWQC was available for a constituent, the USEPA Region 4 value was selected as the ESV. Groundwater discharges to Mill Run Creek immediately east of the site. Because Mill Run Creek is a freshwater body at the discharge point, groundwater data were screened against freshwater ESVs.

When an ESV value was not available for a detected analyte, a supplemental screening value from published literature was used, as available.

Maximum concentrations of metals in surface and subsurface soil were also compared to the BTV for undeveloped areas with combined soil types (CH2M HILL, 2011c). Maximum concentrations of metals in groundwater were also compared to the BTV for the surficial aquifer (CH2M HILL, 2011d). The BTV represents a 95/95 upper tolerance limit (UTL), which is an upper bound (with 95 percent confidence) of the background 95th percentile.

6.3 Screening Results

This section addresses constituents that were detected. Non-detected constituents are not expected to pose a risk to ecological receptors. Table G-4 of **Appendix G** presents the surface soil screen, Table G-5 presents the subsurface soil screen, and Table G-6 presents the groundwater screen.

6.3.1 Surface Soil

Of the detected analytes in surface soil with available ESVs, aluminum, antimony, iron, lead, selenium, vanadium, and zinc had maximum-based HQs greater than one. The maximum concentrations of antimony and selenium were consistent with background. The maximum-based HQ for zinc had a low magnitude of exceedance (HQ less than 3) and the mean-based HQ was less than 1. Lead and vanadium also had a low magnitude of exceedance (HQs less than 2) based on the mean. Aluminum and iron had elevated HQs, however only 1 of the 16 samples for both analytes exceeded the BTV suggesting that these analytes are generally consistent with background. As a result, analytes detected in surface soil are not expected to pose an unacceptable risk to ecological receptors.

6.3.2 Subsurface Soil

In subsurface soil, aluminum, iron, lead, selenium, and vanadium had maximum-based HQs greater than one. The maximum concentrations of aluminum, iron, and vanadium were consistent with background. Lead and selenium both had low magnitudes of exceedance (maximum-based HQs less than 2) and mean-based HQs less than one. As a result, analytes detected in subsurface are not expected to pose an unacceptable risk to ecological receptors.

6.3.3 Groundwater

The detected constituents in groundwater either had maximum-based HQs less than one or were consistent with the BTV. Consequently, analytes detected in groundwater are not expected to pose an unacceptable risk to ecological receptors.

6.4 Summary

Based on the results of the ecological risk screening, analytes detected in surface soil, subsurface soil, and groundwater are not expected to pose an unacceptable risk to ecological receptor populations.

SECTION 7

Conclusions and Recommendations

This section presents the conclusions of the environmental and MEC investigations. Recommendations based on these conclusions are also presented.

7.1 Conclusions

7.1.1 Environmental Investigation

This PA/SI involved the collection of surface soil, subsurface soil, and groundwater samples for analysis of MC. The concentrations of explosives residues and perchlorate were below regulatory criteria in all media. There were no metals detected in exceedance of background or regulatory standards in groundwater samples. The concentrations of seven metals (aluminum, arsenic, cobalt, hexavalent chromium, iron, manganese, and vanadium) in soil samples exceeded regulatory standards and the BTV. However, based on the results of the HHRS and ERS, exposure to surface soil, subsurface soil, and groundwater do not pose unacceptable risks to human health or the environment.

7.1.2 Digital Geophysical Mapping and Intrusive Investigation

The DGM survey was conducted over roughly 2.5 acres (10 percent of UXO-25) in both the north and south areas of Site UXO-25, along approximately 34,074 linear feet of transects. The DGM investigation identified 361 targets with the characteristics of potential MEC. The intrusive investigation of these 361 targets did not recover any MEC, MPPEH, or munitions related debris.

7.2 Recommendations

No further action and closure of the site under the MMRP are recommended for Site UXO-25.

SECTION 8

References

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Appendix A
Archival Records Search Report

Final

Archives Records Search Report
Military Munitions Response Program Site UXO-25 – Verona Loop Munitions Response Site

Marine Corps Base Camp Lejeune
Jacksonville, North Carolina

Contract Task Order WE18

February 2012

Prepared for

Department of the Navy
Naval Facilities Engineering Command
Mid-Atlantic

Under the

NAVFAC CLEAN Program
Contract N62470-08-D-8012

Prepared by

CH2MHILL

11301 Carmel Commons Blvd., Suite 304
Charlotte, North Carolina 28226
NC Engineering License #F-0699

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Attachments

Acronyms and Abbreviations

ARSR	Archival Records Search Report
ASR	Archive Search Report
MCB CamLej	Marine Corps Base Camp Lejeune
MEC	Munitions and Explosives of Concern
MMRP	Military Munitions Response Program
MILCON	military construction
mm	millimeter
MR	Munitions Response
MRS	Munitions Response Sites
PA/SI	Preliminary Assessment/Site Inspection
PRA	Preliminary Range Assessment
USACE	United States Army Corps of Engineers
U.S.	United States
UXO	Unexploded Ordnance

SECTION 1

Introduction, Purpose, and Scope

Marine Corps Base Camp Lejeune (MCB CamLej) will conduct a Preliminary Assessment/Site Inspection (PA/SI) at Military Munitions Response Program (MMRP) Site Unexploded Ordnance (UXO) 25 – Verona Loop Munitions Response Site (MRS) (**Figure 1-1)**. This PS/SI will be used to evaluate the need for additional Munitions Response (MR) activities for the planned military construction (MILCON) and/or environmental remediation activities at this MRS. A detailed description of the proposed PA/SI activities is provided in the *Draft Preliminary Assessment/Site Inspection Work Plan Addendum, Verona Loop Munitions Response Site* (CH2M HILL, 2011).

1.1 Objective

The objectives of this PA/SI are to:

- Evaluate the presence of potential subsurface MEC
- Evaluate the potential presence of soil and groundwater MC contamination within UXO-25.

The Archival Records Search Report (ARSR) will be used to focus the PA/SI investigation on areas where suspected impacts have occurred or are occurring. **Figure 1-2** shows the site as well as surrounding areas.

1.2 Scope

The ARSR includes a review of existing information relating to the sites and the surrounding areas, with an emphasis on information from personnel and historical resources that might indicate the presence of impacted environmental media. The scope of the report includes:

- Review of existing historical information for M-16, Outdoor Classroom, and the Impact Area “M” (including MCB CamLej maps, drawings, reports, and interviews with Base personnel)
- Review of additional information pertaining to the M-16, Outdoor Classroom, and the Impact Area “M” based on the information gathered during the historical records review

A summary of the resources identified and reviewed during the preparation of the ARSR is provided in **Attachment 1** and includes current MCB CamLej records.

SECTION 2

Site Information

2.1 Facility Information

MCB CamLej is located on the Atlantic coast in Jacksonville, North Carolina. The city of Jacksonville, located in Onslow County, is the principal support community for MCB CamLej. The MCB CamLej mission is to maintain combat-ready units for expeditionary deployment.

MCB CamLej occupies 153,000 acres, including more than 450 miles of roads, approximately 6,800 buildings and facilities, and 14 miles of beach on the Atlantic Ocean. Approximately 14,000 acres of land have been developed for administrative, maintenance, logistics, and personnel support facilities. Originally established in 1941, MCB CamLej is home to Marine Expeditionary Force units and the base and surrounding community is home to an active duty, dependent, retiree and civilian employee population of approximately 180,000 people.

2.2 Ownership History

The history of the land now occupied by MCB CamLej is documented primarily through land records and tax maps. In 1941, following the start of World War II, the War Department began purchasing tracts of land from local residents to meet the need for an East Coast amphibious training facility. Prior to the Marines occupation, the land had been occupied by small rural communities and farms. The historical land use consisted of plantation houses, cabins, farm buildings, tobacco barns, stores, and various cemeteries (Global Security Website, 2011).

The initial land acquisition consisted of 14 different transactions between April and October 1941 and totaled 173.8 square miles, or 111,155 acres, of which there were 85,155 land acres and about 26,000 acres under water. The individual tracts of land were grouped into various 'Areas' for consolidation.

The UXO-25 is located within Property Map Area M, between the New River and United States (U.S.) Route 17. **Figure 2-1** shows the property map for Area M (Bureau of Yards and Docks, 1941), which includes UXO-25. Property Area M includes 117 tracts of land acquired by the government from area landowners on August 2, 1941, and is roughly bounded by the New River to the east, Stone Creek to the south, Southwest Creek to the north, and U.S. Route 17 to the west near the town of Verona, North Carolina (USACE, 2001a). Site UXO-25 includes portions of eight tracts of land that were purchased in 1941, as shown in the 1941 Property Map for Area M. The facility was initially referred to as the Marine Barracks New River, which was changed to MCB CamLej in 1942 (Global Security Website, 2011).

2.3 Operational History

Site UXO-25 consists of those portions of two former ranges, the Impact Area "M" range and the M-16, Outdoor Classroom range, that are located west of U.S. Route 17 (**Figure 2-2)**. During the timeframe when the ranges were in use, U.S. Route 17 was located to the west of the range areas. U.S. Route 17 was relocated in 1999 (**Attachment 2**), which left approximately 25 acres of the former range to the west of U.S. Route 17. These areas west of U.S. Route 17 border residential areas of the Verona Township.

Previous studies include the *Preliminary Range Assessment* (PRA) (USACE, 2001a) and *Archive Search Report* (ASR) (USACE, 2001b). Historic information indicates that between 1941 and 1945, Impact Area "M", was possibly used for live fire and maneuver exercises with the use of mortars, recoilless rifles, 2.36-inch rockets, and hand and rifle grenades (**Attachment 3** and **4**) (USACE, 2001a). The former Impact Area "M" range is described as being bounded by U.S. Route 17, Stone Creek, New River, Mill Creek, Verona Loop Road, Lewis Creek, New River, and Southwest Creek (USACE, 2001a). Camp Training Order 5-1946, dated March 19, 1946, states that the former Impact Area "M" range has been disestablished and is no longer used for the firing of live ammunition (USACE, 2001a).

During the 1950s and 1960s, numerous artillery ranges were located within Impact Area "M" (**Table 2-1**) (**Attachment 3** and **4**) (USACE, 2001a, USACE, 2001b). A detailed description of the ranges found within Impact

Area “M” can be found in the ASR (USACE, 2001b). The existing conditions map from 1979 (**Attachment 5**) also indicates three additional ranges: M-107 Hand Grenade Range, M-109 Infiltration Course, and M-118 Individual Movement Day range within area “M”. Site UXO-25 is not located within these ranges, and it is unlikely that Site UXO-25 has been impacted by activities at these locations.

The only reference to the M-16, Outdoor Classroom, is a range map dated 1958. Historical range information indicates that 0.30-caliber blanks may have been used, along with pyrotechnics. The pyrotechnic munitions are known to contain a filler that is extremely sensitive to heat, shock, and friction. This area is no longer used for the firing of live ammunition. Personal communication with Mr. Ben Redmond, a former range control officer at MCB CamLej, indicated that M-16, Outdoor Classroom, was an assembly area consisting of a set of bleachers used for teaching purposes. Mr. Redmond also indicated that “the impact area for mortars and artillery was well to the east (of the subject site), and a lot of the munitions listed (on the PRA) were not used” (Redmond, 2011).

Artillery Training Area 1941 (**Plat 2** of **Attachment 4**) extends into Impact Area “M” and ends approximately 1,500 meters east of UXO-25. The PRA (USACE, 2001a) assumes that 75-millimeter (mm), 105-mm, and 155-mm Howitzers were used in this range from 1941 to 1943. Impacts from Artillery Training Area 1941 would not be expected within UXO-25.

2.4 Ongoing Site Investigations

There have been no known environmental investigations performed near UXO-25.

SECTION 3

Findings

Based on the historical records review, UXO-25 is located on the western portion of ranges where blank ammunition, pyrotechnics, mortars, recoilless rifles, 2.36-inch rockets, 0.30-caliber blanks, and hand and rifle grenades may have been used (USACE, 2001b). Based on the nearby location of churches, residential areas near Verona, North Carolina, and the proximity to and relocation of U.S. Route 17, there is a low probability that MEC exists at UXO-25.

SECTION 4

References

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Tables

TABLE 2-1
Impact Area "M" Ranges - 1958 to 1969
Verona Loop Munitions Response Site
MCB CamLej, North Carolina

RANGE	DESCRIPTION	MUNITION TYPES
M-4	Rifle Grenade Range	.30 Caliber, M3 Crimped Cartridges, M28 Rifle Grenade, M29 Rifle Grenade, White Phosphorous Hand and Rifle Grenade, Pyrotechnics and Demolitions
M-4A	Practice Hand Grenade Course	Practice Hand Grenades
M-5	Practice Rifle Grenade Range	M29 Practice Rifle Grenade
M-6	Infiltration Course	Small Arms and Demolitions (1/4 pound)
M-7	Landscape Range (a.k.a. 1000-Inch Machine Gun Range)	.30 Caliber Weapons (Pistols and Revolvers), Riot Guns
M-8	Assault of a Fortified Position	M1 Rifles, Flame Throwers, and 3.5-inch Rocket Launchers
M-9	Combat Village Area	Small Arms (Blanks), Boobytrap Devices, Practice Hand Grenades and Land Mines, Pyrotechnics, Smoke Grenades
M-10	Hand Grenade Range	WP and HE Hand Grenades
M-11	Assault on a Fortified Position Area	Small Arms, Practice Rifle Grenades, WP Hand and Rifle Grenades, Pyrotechnics, and Demolitions
M-15	Mine, Booby Trap Display Area (a.k.a. M-15 Mine Field Disposal Area)	Practice Mines, Improvised Mines, and Booby Trap Devices
M-16	Outdoor Classroom	Blank Ammunition and Pyrotechnics
M-17	Practice Hand and Rifle Grenade Range	Practice Grenades

Figures

V:\USNAVFACENGCOM\CAMPLEJEUNE\MAPFILES\VERONA_LOOP\MAASR\FIGURE_1-1_BASE_MAP_VERONA_LOOP.MXD MARTESE 9/19/2011 10:41:42 AM

Legend

- Highways
- Installation Boundary
- Verona Loop Munitions Response Site

N

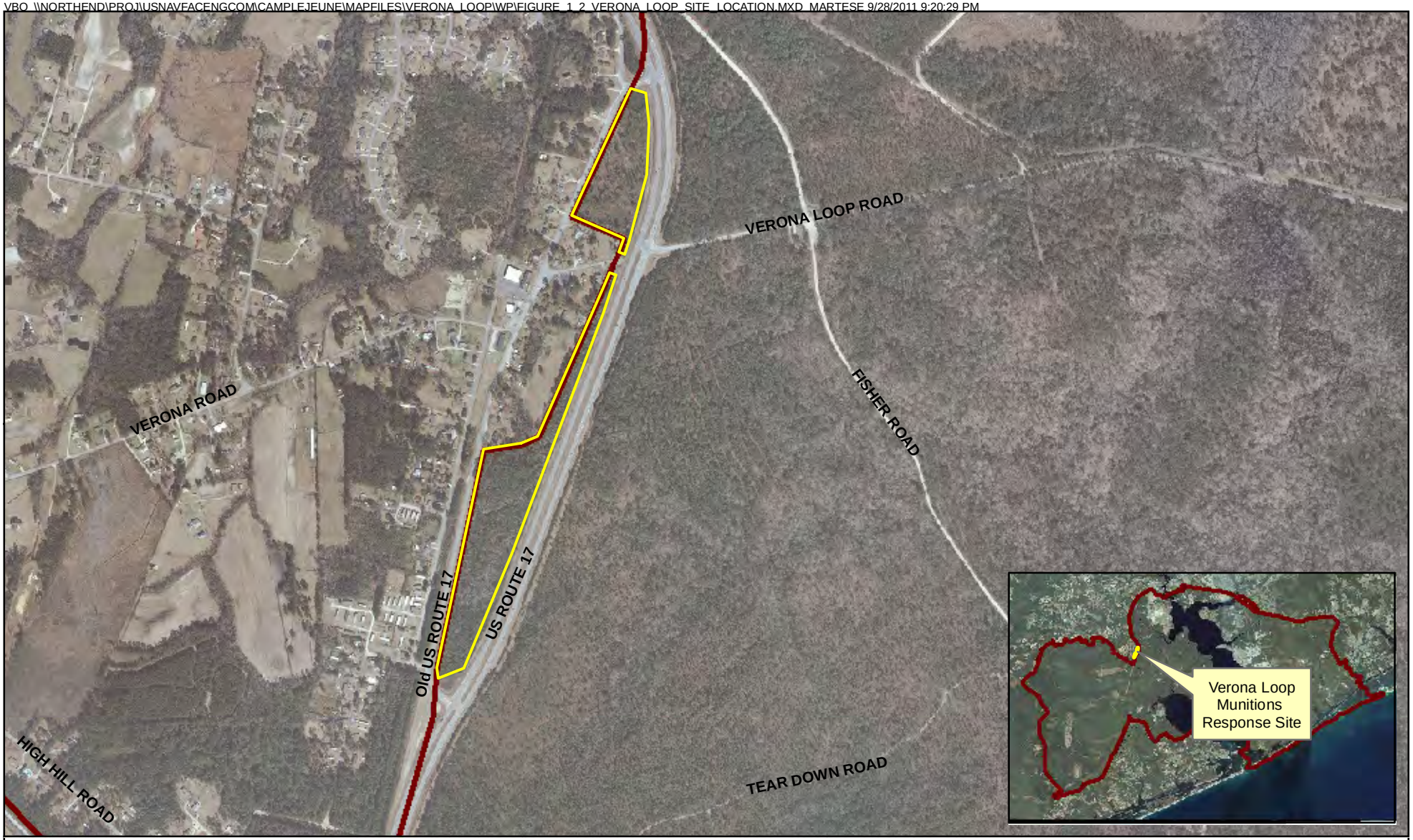
0 7,500 15,000 30,000 Feet

1 inch = 15,000 feet

Figure 1-1
Base Location Map
Verona Loop Munitions Response Site
MCB CamLej
North Carolina

CH2MHILL

VBO \\NORTHEND\PROJ\USNAVFACENGCOM\CAMPLEJEUNE\MAPFILES\VERONA_LOOP\WP\FIGURE_1_2_VERONA_LOOP_SITE_LOCATION.MXD MARTESE 9/28/2011 9:20:29 PM



Legend

- Verona Loop Munitions Response Site
- Installation Boundary

N

0 500 1,000 2,000 Feet

1 inch = 1,000 feet

Figure 1-2
Site Location Map
Verona Loop Munitions Response Site
MCB CamLej
North Carolina

CH2MHILL

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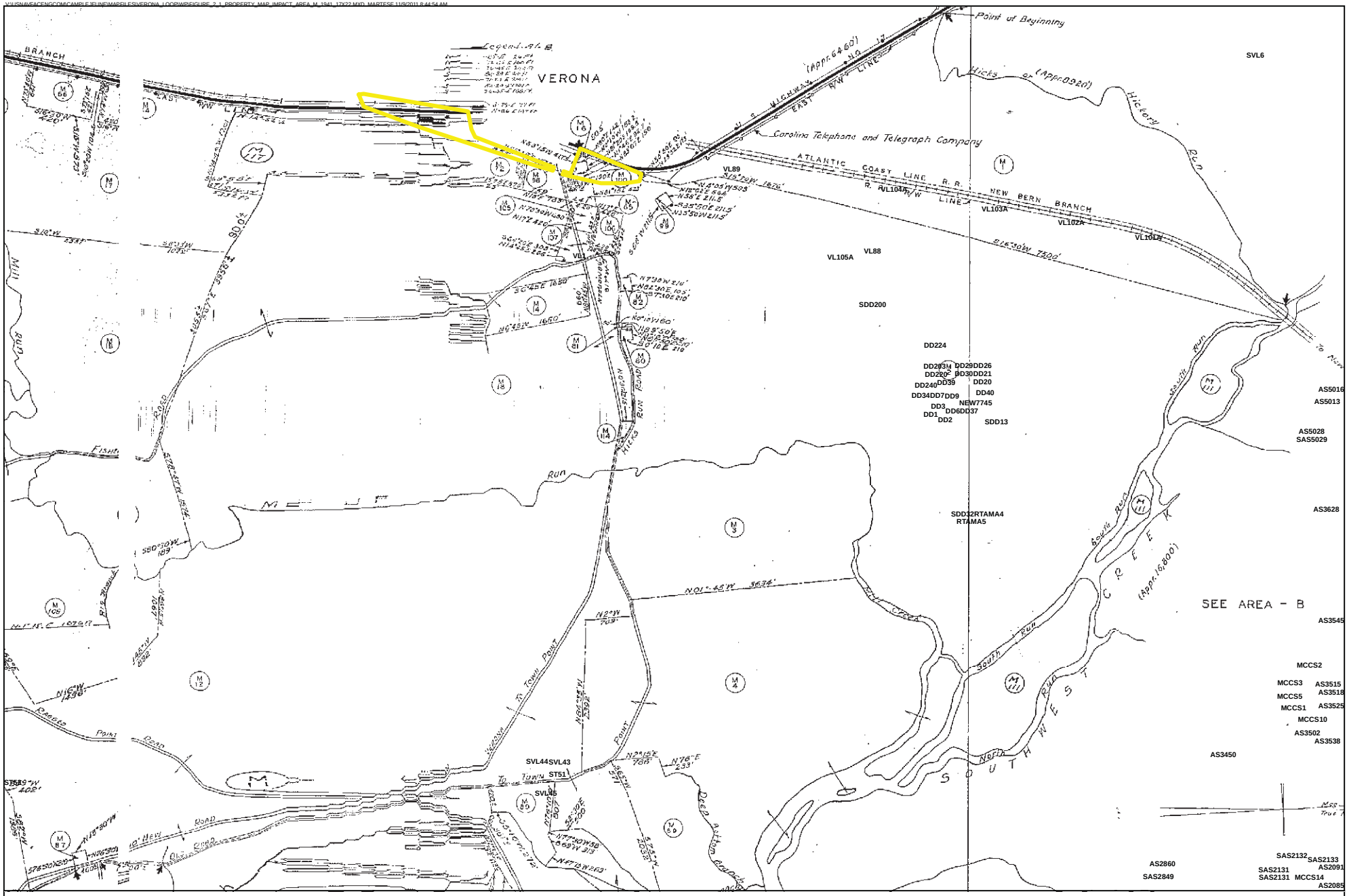


Legend

Verona Loop Munitions Response Site

0 500 1,000 2,000 3,000 Feet

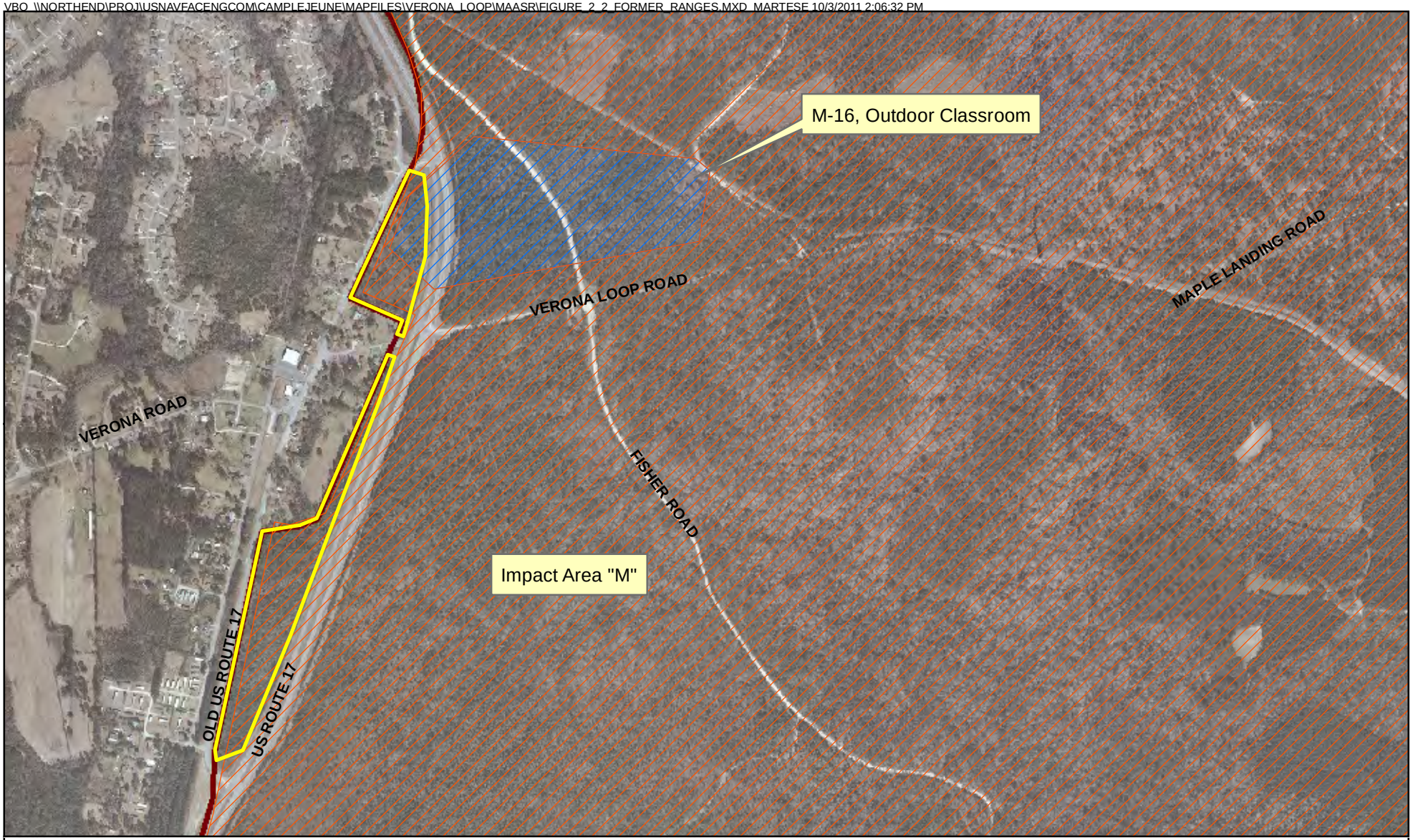
1 inch = 1,000 feet

Figure 2-1
Property Map Area "M" - 1941
Verona Loop Munitions Response Site
MCB CamLej
North Carolina

Notes:
Figure derived from Property Map of Area M (Bureau of Yards and Docks, 1941)
Scale unavailable

CH2MHILL

VBO \\NORTHEND\PROJ\USNAVFACENGCOM\CAMPLEJEUNE\MAPFILES\VERONA_LOOP\MAASR\FIGURE_2_2_FORMER_RANGES.MXD MARTESE 10/3/2011 2:06:32 PM



Legend

- Verona Loop Munitions Response Site
- Impact Area "M"
- M-16, Outdoor Classroom
- Installation Boundary

N

0 500 1,000 2,000 Feet

1 inch = 1,000 feet

Figure 2-2
Former Range Areas Location Map
Verona Loop Munitions Response Site
MCB CamLej
North Carolina

CH2MHILL

Attachment 1
Resource Review Summary

Resource Review Summary

The following table provides a summary of the specific references identified for review, interview, or contact for the archival report.

Resource	Actions Completed
Camp Lejeune Real Estate Office	Obtained all relevant documents related to historical land use.
Camp Lejeune Public Works Office	Obtained all relevant documents related to historical land use.
Camp Lejeune Personnel	
Rachel Johnston/Combat Camera Archives	Contacted and phone interviewed (August 25, 2011)
Rick Richardson/Base Archaeologist/Cultural Resources Program Manager	Contacted via e-mail (September 15, 2011)

A.1 MCB Camp Lejeune Base Records Review

Contact: Alice Bonnette
Technical Records, Public Works Office
Marine Corps Base, Camp Lejeune
(910) 451-2818 ext 273

Per phone and e-mail, conversations provided floor and site plans to all buildings requiring a public works contract as well as an Existing Conditions Map for the Verona Loop Munitions Response Area - 1979.

Contact: Linda Rose Futrell
Realty Specialist, Public Works Division
Marine Corps Base, Camp Lejeune
(910) 451-2818 x271
(910) 545-9269 (cell)

Provided map of the land the Government purchased in 1941 for the Area M that includes the Verona Loop Munitions Response Area.

Property Map, Area M. Marine Barrack, New River, NC. Bureau of Yards and Docks, 1941.

Contact: Rachel Johnstone
Archivist, Combat Camera
Marine Corps Base, Camp Lejeune
(910) 451-1238

Currently the office holds photos and oral histories of the main area of MCB CamLej and the collection is growing. Specifically, photographs of range area M-113 and M-115 were found, two range areas within Impact Area "M". These ranges are located approximately 1.6 miles northeast of the VLMRA.

Contact: Rick Richardson
Base Archaeologist/Cultural Resources Program Manager
Marine Corps Base Camp Lejeune, NC 28542
(910)451-7230

Currently the office holds histories of the cultural resource areas within MCB CamLej. Based on information provided by Mr. Richardson, there are no archaeological sites in the Verona Loop Munitions Response Area (yellow boundary area on site figures), and only one ineligible archaeological site in the M-16 Outdoor Classroom

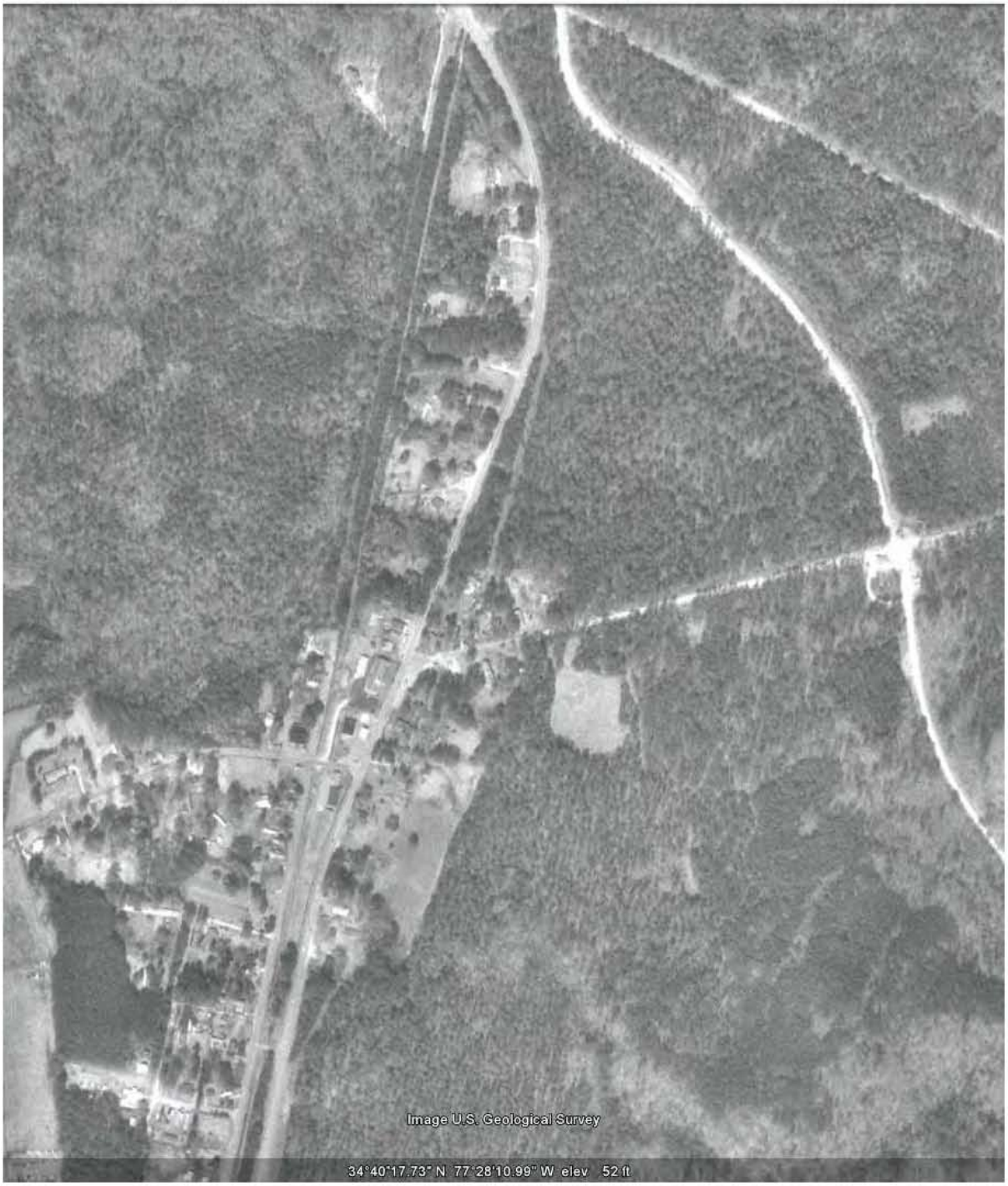
area at far eastern edge (sensitivity to cultural information in this area prohibits the specific location from being shown on a map).

A cultural survey was conducted in the Verona Loop Munitions Response Area in 1991 by Louis Berger and Associates for the North Carolina Department of Transportation as part of the US Hwy 17 widening, and a portion of the M-16 Outdoor Classroom area was surveyed in 1993 by Goodwin and Associates for Wastewater Treatment Upgrade project. The survey did not indicate any archaeological/cultural sites within the Verona Loop Munitions Response Area. The ineligible archaeological site at the at far eastern edge of theM-16 Outdoor Classroom is outside of the Verona Loop Munitions Response Area where the environmental investigation is to take place.

Attachment 2
Historical Photos

1958 Aerial of Air Station and Verona Loop

1972 Aerial of Verona Loop Area



1993 Aerial of Verona Loop – Pre-construction for widening of US Hwy 17

1999 Aerial of Verona Loop – Shows construction (widening) of US Hwy 17

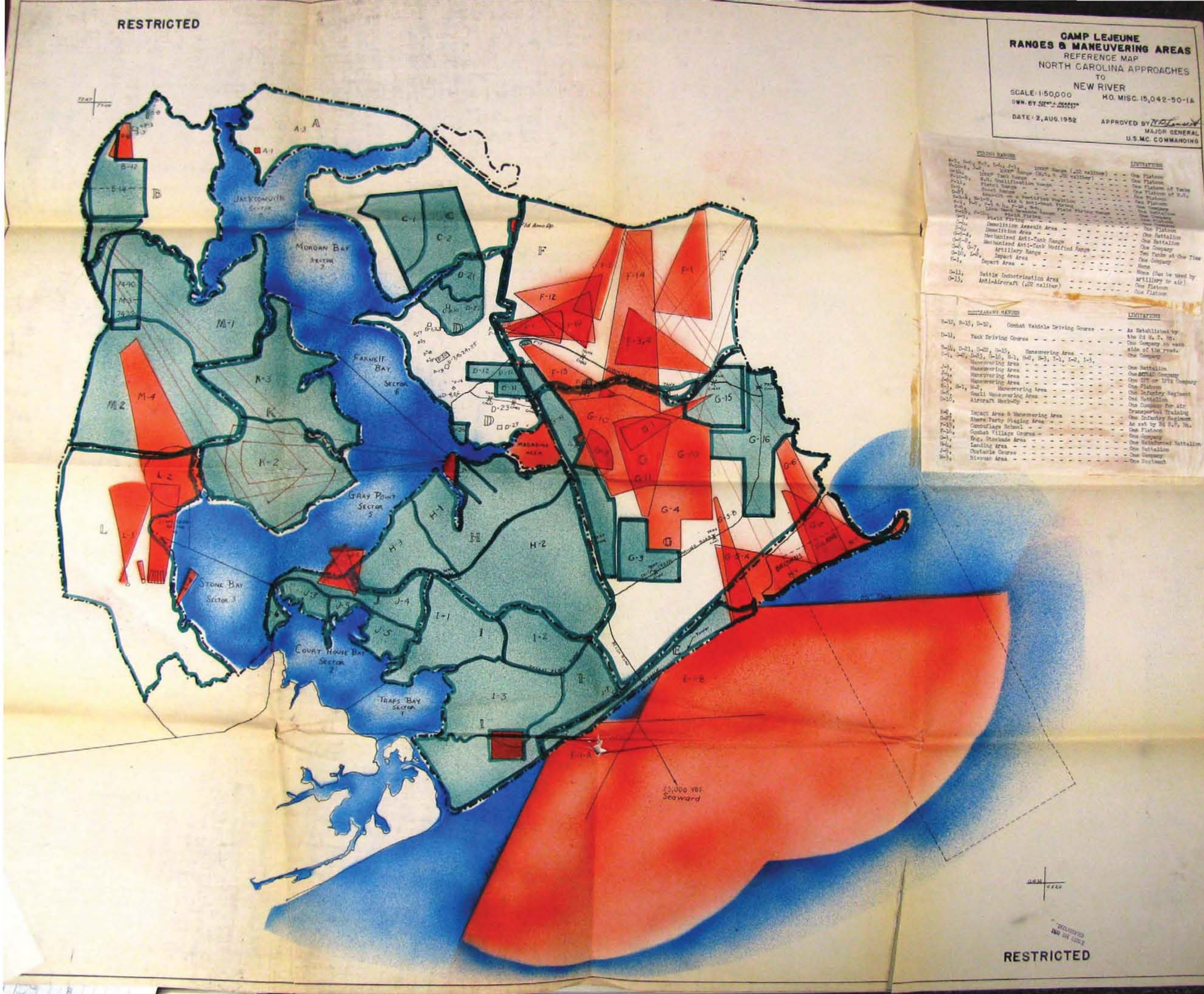
Date Unknown – Historical Photograph of M-113 Range Area (courtesy of Combat Camera Archives)

Date Unknown – Historical Aerial of M-113 Range Area (courtesy of Combat Camera Archives)

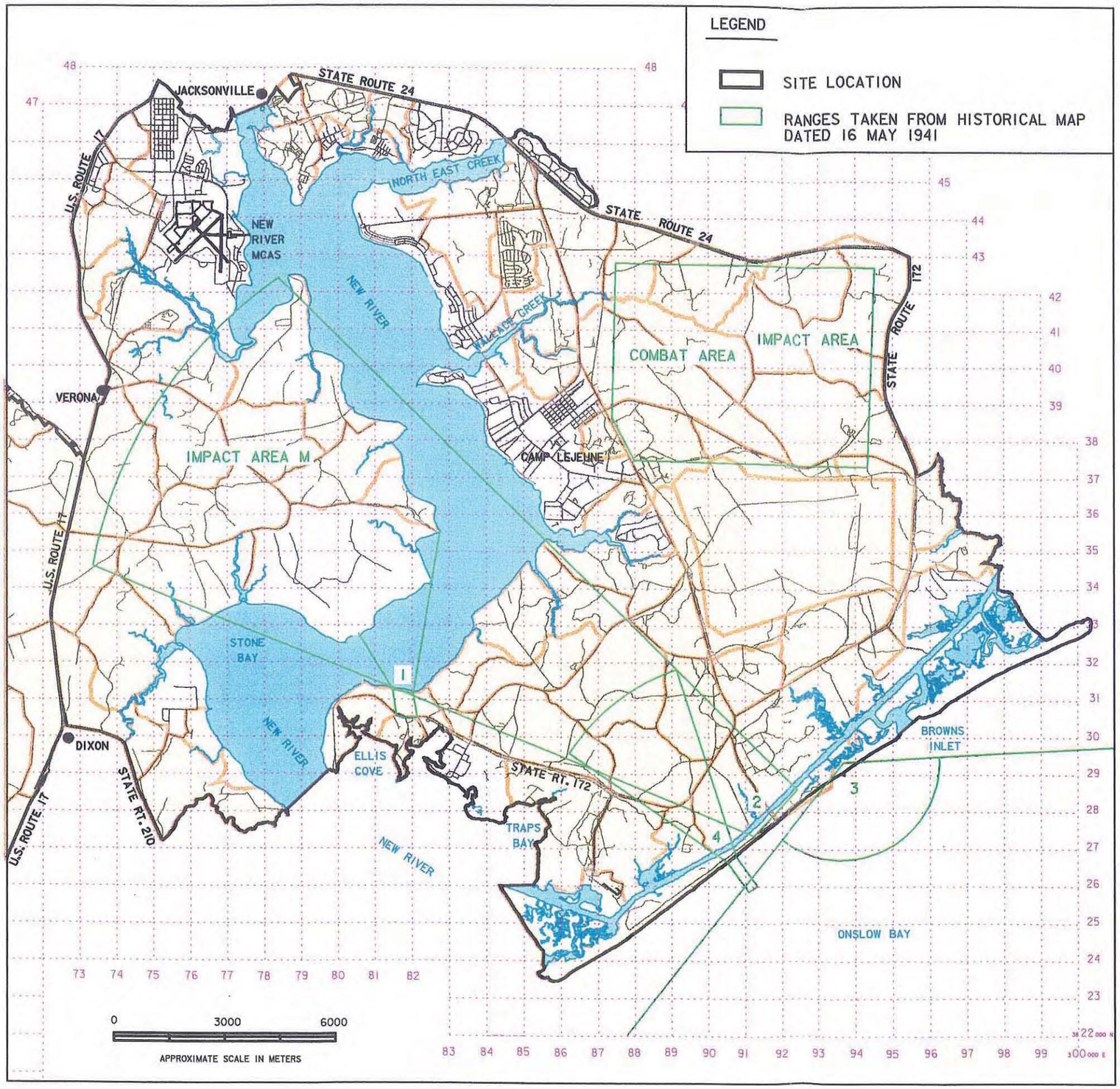
Date Unknown – Historical Photograph of M-115 Range Area (courtesy of Combat Camera Archives)

Date Unknown – Historical Aerial of M-115 Range Area (courtesy of Combat Camera Archives)

Attachment 3
1952 Ranges and Maneuvering Reference Map


RESTRICTED
CAMP LEJEUNE
RANGES & MANEUVERING AREAS
REFERENCE MAP
NORTH CAROLINA APPROACHES
TO
NEW RIVER
SCALE: 1:50,000
H.O. MISC. 15,042-50-1A
DATE: 2, AUG. 1952
APPROVED BY
MAJOR GENERAL
U.S.M.C. COMMANDING
LIMITATIONS
Demolition Assault Area - One Platoon
Demolition Area - One Battalion
Mechanized Anti-Tank Range - One Battalion
Mechanized Anti-Tank Modified Range - One Company
Artillery Range - Two Tanks at One Time
Impact Area - One Company
Impact Area - None
G-11, Battle Indoctrination Area - None (Can be used by artillery or air)
G-13, Anti-Aircraft (.22 caliber) - One Platoon
LIMITATIONS
Combat Vehicle Driving Course - As Established by the 2d M. T. Bn.
D-11, Tank Driving Course - One Company on each side of the road.
Maneuvering Area - One Company
Maneuvering Area - One Battalion
Maneuvering Area
Maneuvering Area
Maneuvering Area - One Platoon
Small Maneuvering Area - One Infantry Regiment
Aircraft Mock-Up - One Battalion
Impact Area & Maneuvering Area - One Company for Air Transported Training
Shore Party Staging Area - One Infantry Regiment
Camouflage School - One Platoon
Combat Village Course - One Company
Eng. Stockade Area - One Reinforced Battalion
Landing Area - One Battalion
Obstacle Course - One Company
Bivouac Area - One Regiment
A
A-3
A-1
B
B-12
B-14
JACKSONVILLE
MORGAN BAY
SECTOR 7
C
C-1
C-2
D-21
D
D-12
D-11
D-23
D-27
Fld Amo Dp
F
F-12
F-14
F-1
F-13
G-15
G-16
G-10
G-1
G
G-11
G-4
G-6
G-5-B
G-5-A
G-3
MAGAZINE AREA
FARNELL BAY
SECTOR 6
M-1
M-2
M-4
K-3
K
K-2
GRAY POINT
SECTOR 5
H-1
H
H-2
H-3
L
L-2
L-3
STONE BAY
SECTOR 3
J-3
J-4
J-5
I-1
I
I-2
I-3
COURT HOUSE BAY
SECTOR 2
TRAPS BAY
SECTOR 1
E
E-1-B
E-1-A
25,000 YDS. Seaward
BROWNS
RESTRICTED

Attachment 4
Range and Maneuvering Maps



KEY TO FEATURES:

FEATURE NUMBER	FEATURE DESCRIPTION
1.	ANTI-MECHANIZED RANGE
2.	ARTILLERY TRAINING AREA (1941)
3.	ONSLOW BEACH / HURST BEACH FIRING AREA
4.	BOAT GUN RANGE "J" LOCATION

NOTE: HISTORICAL MAP SHEET DATA USED IN THIS REPORT WAS RECTIFIED TO A CURRENT MAP PROVIDED BY MCB CAMP LEJEUNE USING INTERGRAPH CORPORATION SOFTWARE. THE ACCURACY OF FEATURES RECTIFIED FROM THE HISTORICAL MAP SHEET DATA TO THE CURRENT MCB CAMP LEJEUNE MAP MAY VARY.

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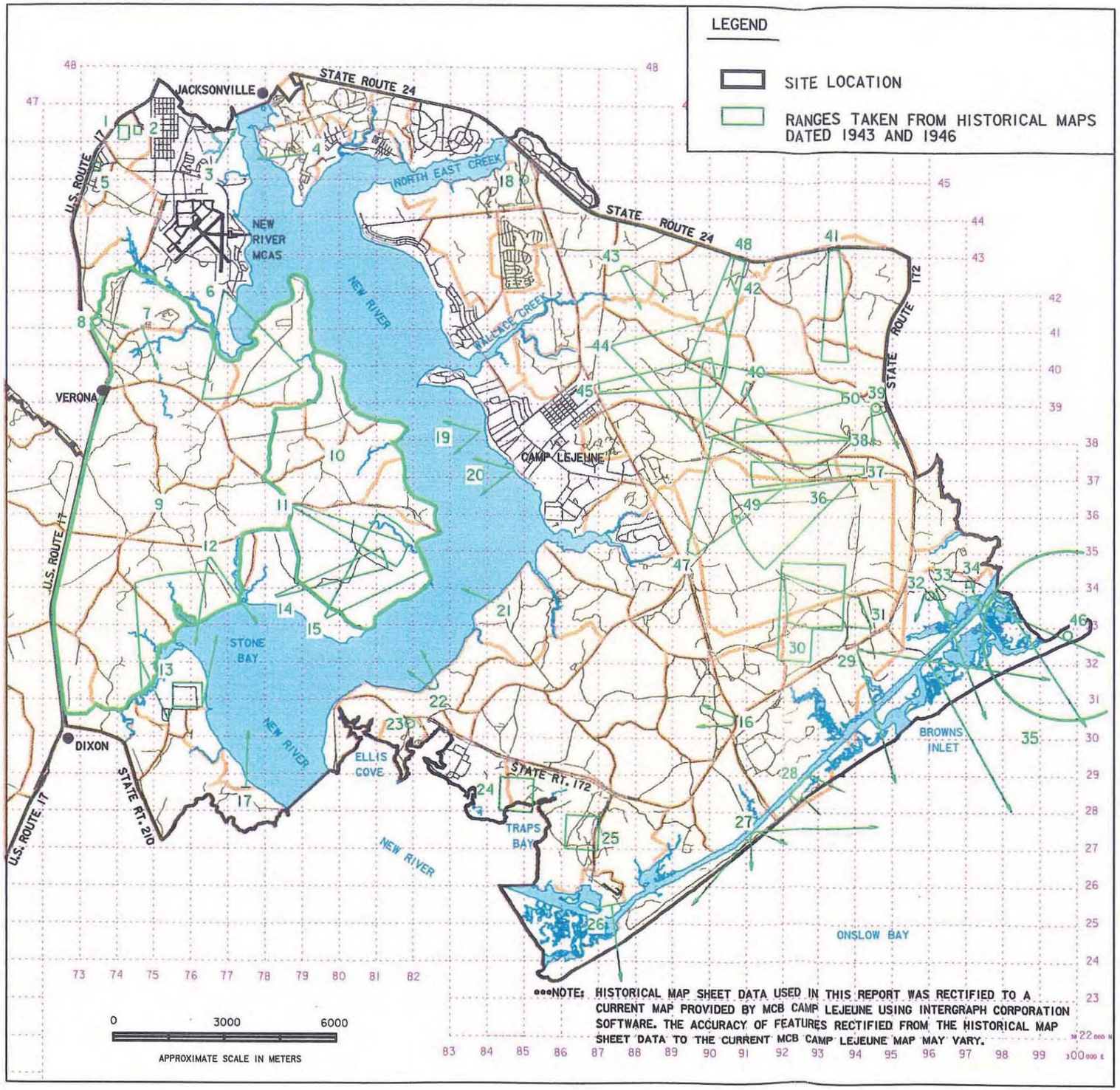
U.S. ARMY CORPS OF ENGINEERS
ST. LOUIS DISTRICT

MARINE CORPS BASE (MCB) CAMP LEJEUNE JACKSONVILLE, NORTH CAROLINA ONSLOW COUNTY RANGE OVERLAY MAP - MAY 1941

PROJ. DATE: SEPT. 1999	DATE OF BASE MAP: 1998	PLATE NO. 2
15-FEB-2000 12:03	n:\dgn\northcarolina\lejeune\16MAY41.DGN	



***NOTE: HISTORICAL MAP SHEET DATA USED IN THIS REPORT WAS RECTIFIED TO A CURRENT MAP PROVIDED BY MCB CAMP LEJEUNE USING INTERGRAPH CORPORATION SOFTWARE. THE ACCURACY OF FEATURES RECTIFIED FROM THE HISTORICAL MAP SHEET DATA TO THE CURRENT MCB CAMP LEJEUNE MAP MAY VARY.

KEY TO FEATURES:

FEATURE NUMBER	FEATURE DESCRIPTION
1.	1000 INCH RANGE (TENT CAMP AREA 1943)
2.	MINATURE ANTI-AIRCRAFT (TENT CAMP AREA 1943)
3.	LIVE AMMUNITION INDOCRINATION COURSE (1945)
4.	1000 INCH RANGE, MONFORD POINT (1946)
5.	MINIATURE ANTI-TANK RANGE (TANK BATLLION TENT CAMP-1943)
6.	INFANTRY WEAPONS DEMOLITION COURSE (1946)
7	MORTAR RANGE M-1 (1945)
8.	ARTILLERY FIRING POINT #7 (1946)
9.	IMPACT AREA (1945)
10.	IMPACT AREA K (1946)
11.	MUSKETRY RANGE E (1945)
12.	MORTAR RANGE L-1 (1946)
13	RIFLE RANGE (1943)
14.	MACHINE GUN RANGE D (1943)
15	MUSKETRY RANGE D (1943)
16.	ARTILLERY FIRING POINT #4 (1943)
17.	MORTAR RANGE L-2 (1945)
18.	LIVE HAND GRENADE COURSE (1945)
19.	DEMOLITION FIRING POINT #1 (1945)
20.	FIRING POINT #5 (1945)
21.	ARTILLERY FIRING POINT #10 (1945)
22.	ARTILLERY FIRING POINT #6 (1946)
23.	1000 INCH RANGE (AMPHIBIAN BASE AREA-1946)
24.	ENGINEER FIRING AREA (1947)
25.	ENGINEER FIRING AREA (1947)
26.	ARTILLERY FIRING POINT #2 (1945)
27.	ARTILLERY FIRING POINT #5 (1946)
28.	ENGINEER BEACH DEMOLITIONS AND TRAINING AREA (1946)
29.	ANTI-TANK RANGE (1943)
30.	ENGINEER FIRING RANGE (1947)
31.	ENGINEER FIRING RANGE (1946)
32.	ARTILLERY FIRING POINT #3 (1946)
33.	DIRECT FIRE ARTILLERY RANGE (1947)
34.	BEACH ARTILLERY FIRING POINT (1945)
35.	STRAFING TARGET #2 (1946)
36.	MUSKETRY RANGE C-1 (1943)
37.	MUSKETRY RANGE C (1943)
38.	MACHINE GUN RANGE C (1943)
39.	ARTILLERY FIRING POINT #2 (1946)
40.	ARTILLERY FIRING POINT #14 (1945)
41.	MACHINE GUN RANGE A (1943)
42.	ARTILLERY FIRING POINT #8 (1945)
43.	ARTILLERY FIRING POINT #1 (1946)
44.	MUSKETRY RANGE B (1943)
45.	MACHINE GUN RANGE B (1943)
46.	ROCKET RANGE #1 (1946)
47.	MINIATURE ANTI-AIRCRAFT RANGE (AREA D AND F 1943)
48.	MUSKETRY RANGE A (1943)
49.	OC BATTALION FIELD FIRING RANGE (1943)
50.	MUSKETRY RANGE C-2

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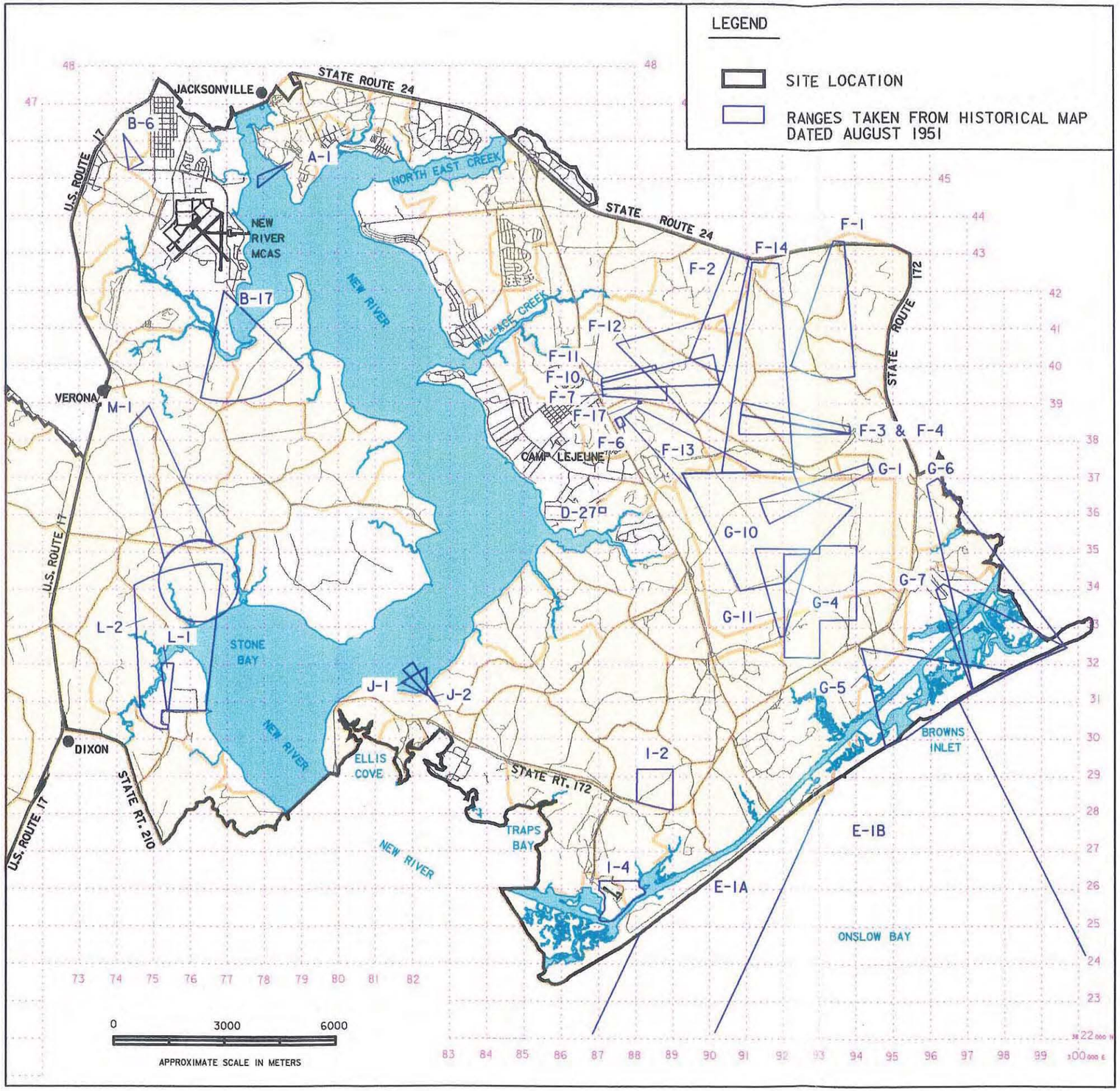
U.S. ARMY CORPS OF ENGINEERS
ST. LOUIS DISTRICT

MARINE CORPS BASE (MCB) CAMP LEJEUNE JACKSONVILLE, NORTH CAROLINA ONSLOW COUNTY RANGE OVERLAY MAP-1946

PROJ. DATE: SEPT. 1999	DATE OF BASE MAP: 1998	PLATE NO. 4
29-FEB-2000 13:51	n:\oew\northcarol\lejeune\40SQUADR.DGN	



KEY TO FEATURES:

FEATURE NUMBER	FEATURE DESCRIPTION
A-1	50 FOOT .22 CALIBER RANGE
B-6	50 FOOT SMALL ARMS RANGE
B-17	INFANTRY WEAPONS DEMOSTRATION COURSE
D-27	FORTIFIED BEACH ASSAULT AREA
E-1A	AAA AND ANTI-BOAT FIRING RANGE
E-1B	AAA AND ANTI-BOAT FIRING RANGE
F-1	FIELD FIRING RANGE
F-2	FIELD FIRING RANGE
F-3	FIELD FIRING RANGE
F-4	FIELD FIRING RANGE
F-6	LIVE HAND GRENADE RANGE
F-7	.22 CALIBER RANGE, 1000 INCH
F-10	MACHINE GUN QUALIFICATION RANGE
F-11	PISTOL RANGE
F-12	FIELD FIRING RANGE
F-13	FIELD FIRING RANGE
F-14	FIELD FIRING RANGE
F-17	DRY NET MOCK-UP
G-1	COMBAT RANGE
G-4	DEMOLITIONS ASSAULT COURSE
G-5	ANTI-TANK RANGE
G-6	ARTILLERY RANGE
G-7	DIRECT FIRE ARTILLERY RANGE
G-10	IMPACT AREA
G-11	BATTLE INDOCTRINATION COURSE
I-2	DEMOLITION RANGE
I-4	DEMOLITION AREA
J-1	1000 INCH RANGE
J-2	1000 INCH RANGE
L-1	PISTOL RANGE
L-2	RIFLE RANGE
M-1	RANGE M-1

***NOTE: HISTORICAL MAP SHEET DATA USED IN THIS REPORT WAS RECTIFIED TO A CURRENT MAP PROVIDED BY MCB CAMP LEJEUNE USING INTERGRAPH CORPORATION SOFTWARE. THE ACCURACY OF FEATURES RECTIFIED FROM THE HISTORICAL MAP SHEET DATA TO THE CURRENT MCB CAMP LEJEUNE MAP MAY VARY.

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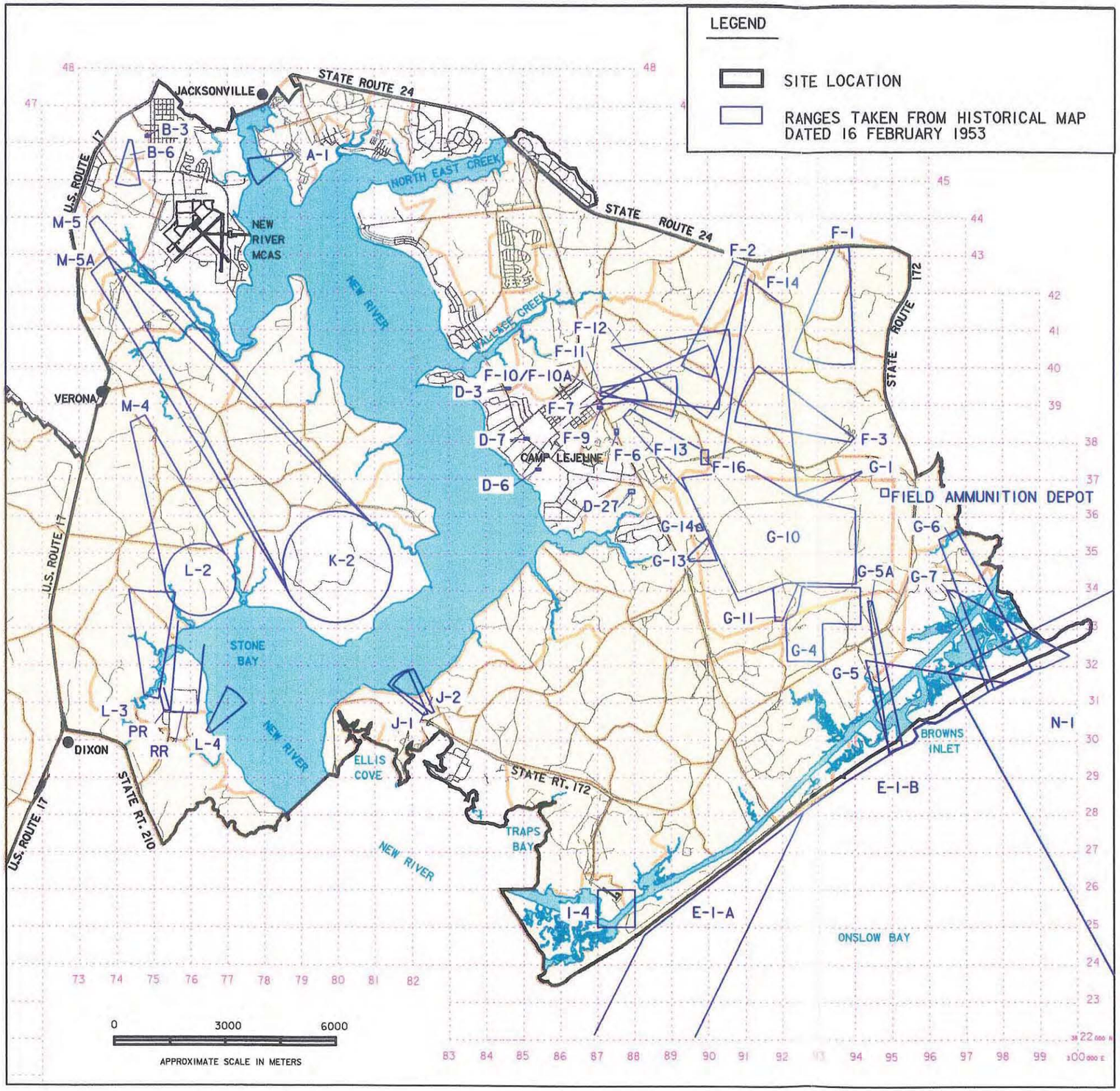
U.S. ARMY CORPS OF ENGINEERS
ST. LOUIS DISTRICT

MARINE CORPS BASE (MCB) CAMP LEJEUNE JACKSONVILLE, NORTH CAROLINA ONSLOW COUNTY RANGE OVERLAY MAP-AUGUST 1951

PROJ. DATE: SEPT. 1999	DATE OF BASE MAP: 1998	PLATE NO. 5
10-MAR-2000 12:40	n:\oew\northcarol\lejeune\aug51r.dgn	



KEY TO FEATURES:

FEATURE NUMBER	FEATURE DESCRIPTION
A-1	50 FOOT .22 CALIBER RANGE
B-3	GAS CHAMBER
B-6	1000 INCH RANGE
D-3	PRACTICE HAND GRENADE COURSE
D-6	PRACTICE HAND GRENADE COURSE
D-7	GAS CHAMBER
D-27	FORTIFIED BEACH ASSAULT AREA
E-1A	AAA AND ANTI-BOAT RANGE
E-1B	AAA AND ANTI-BOAT RANGE
F-1	FIELD FIRING RANGE
F-2	FIELD FIRING RANGE
F-3	FIELD FIRING RANGE
F-6	LIVE HAND GRENADE RANGE
F-7	1000 INCH RANGE
F-9	TRIANGULATION RANGE
F-10	MACHINE GUN QUALIFICATION RANGE
F-10A	1000 INCH RANGE
F-11	PISTOL RANGE
F-12	FIELD FIRING RANGE
F-13	FIELD FIRING RANGE
F-14	FIELD FIRING RANGE
F-16	COMBAT VILLAGE
G-1	COMBAT RANGE
G-4	ASSAULT DEMOLITION AREA
G-5	ANTI-TANK RANGE
G-5A	MECHANIZED ANTI-TANK RANGE
G-6	ARTILLERY RANGE
G-7	DIRECT FIRE ARTILLERY RANGE
G-10	IMPACT AREA
G-11	BATTLE INDOCTRINATION RANGE
G-13	MINIATURE ANTI-AIRCRAFT RANGE
G-14	TANK MACHINE GUN RANGE
I-4	DEMOLITION AREA
J-1	1000 INCH RANGE
J-2	1000 INCH RANGE
K-2	IMPACT AREA
L-2	IMPACT AREA
L-3	MACHINE GUN TRANSITION RANGE
L-4	1000 INCH RANGE
M-4	FIELD FIRING RANGE
M-5	ARTILLERY RANGE
M-5A	ARTILLERY RANGE
N-1	DANGER AREA
PR	PISTOL RANGE
RR	RIFLE RANGE

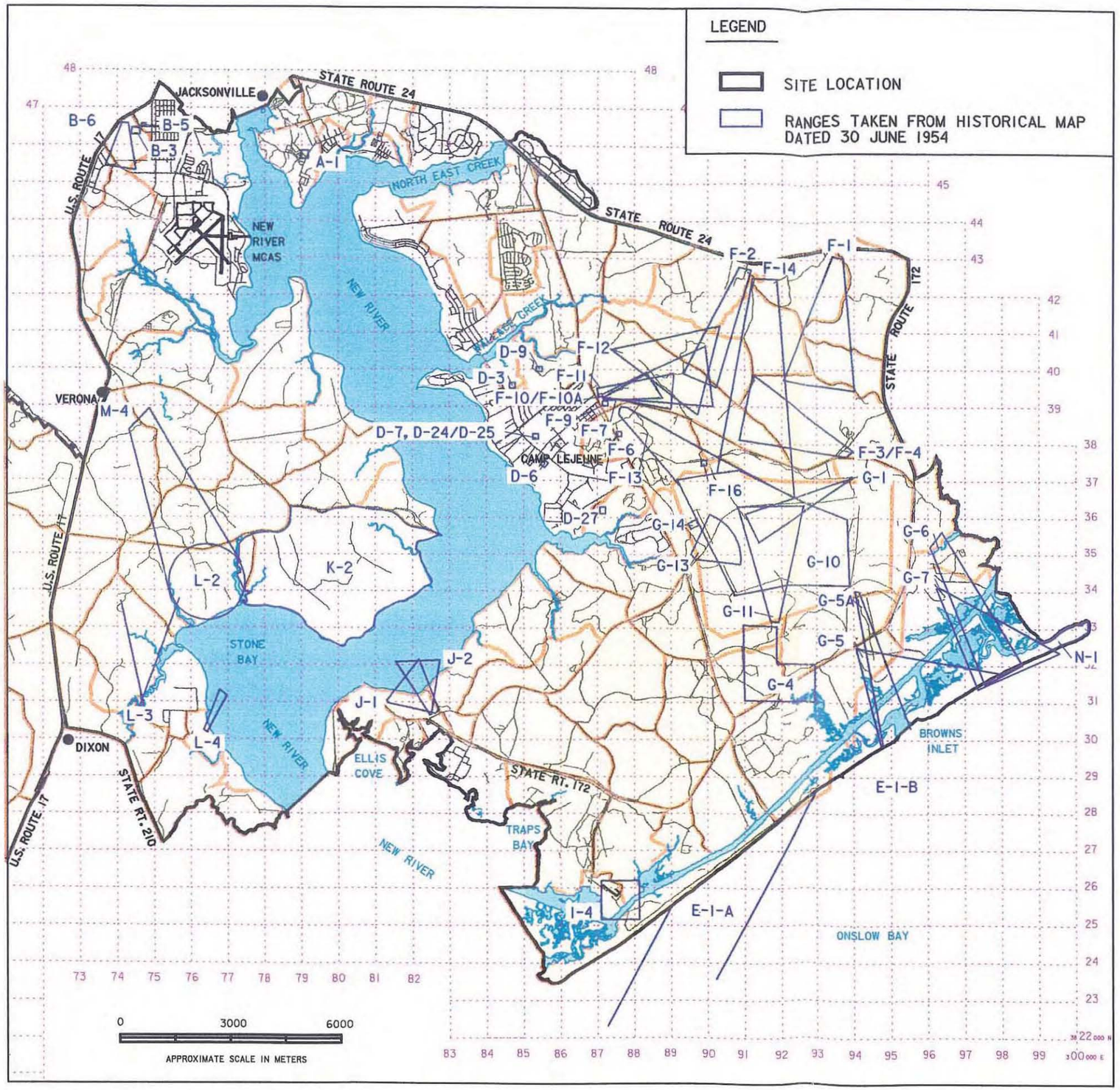
***NOTE: HISTORICAL MAP SHEET DATA USED IN THIS REPORT WAS RECTIFIED TO A CURRENT MAP PROVIDED BY MCB CAMP LEJEUNE USING INTERGRAPH CORPORATION SOFTWARE. THE ACCURACY OF FEATURES RECTIFIED FROM THE HISTORICAL MAP SHEET DATA TO THE CURRENT MCB CAMP LEJEUNE MAP MAY VARY.

N

U.S. ARMY CORPS OF ENGINEERS
ST. LOUIS DISTRICT

MARINE CORPS BASE (MCB) CAMP LEJEUNE JACKSONVILLE, NORTH CAROLINA ONSLOW COUNTY RANGE OVERLAY MAP-FEBRUARY 1953

PROJ. DATE: SEPT. 1999	DATE OF BASE MAP: 1998	PLATE NO. 6
10-MAR-2000 12:58	n:\cew\northcarol\lejeune\16feb53.dgn	



KEY TO FEATURES:

FEATURE NUMBER	FEATURE DESCRIPTION
A-1	50 FOOT .22 CALIBER RANGE
B-3	GAS CHAMBER
B-5	PRACTICE HAND GRENADE COURSE
B-6	50 FOOT SMALL ARMS RANGE
D-3	PRACTICE HAND GRENADE COURSE
D-6	PRACTICE HAND GRENADE COURSE
D-7	GAS CHAMBER
D-9	SKEET RANGE
D-27	FORTIFIED BEACH ASSAULT AREA
E-1A	AAA AND ANTI-BOAT FIRING RANGE
E-1B	AAA AND ANTI-BOAT FIRING RANGE
F-1	FIELD FIRING RANGE
F-2	FIELD FIRING RANGE
F-3	FIELD FIRING RANGE
F-4	FIELD FIRING RANGE
F-6	LIVE HAND GRENADE RANGE
F-7	.22 CALIBER RANGE 1000 INCH
F-9	TRIANGULATION RANGE
F-10	1000 INCH RANGE
F-10A	MACHINE GUN QUALIFICATION RANGE
F-11	PISTOL RANGE
F-12	FIELD FIRING RANGE
F-13	FIELD FIRING RANGE
F-14	FIELD FIRING RANGE
F-16	COMBAT VILLAGE
G-1	COMBAT RANGE
G-4	DEMOLITION ASSAULT COURSE
G-5	ANTI-TANK RANGE
G-5A	MECHANIZED ANTI-TANK RANGE
G-6	ARTILLERY RANGE
G-7	DIRECT FIRE ARTILLERY RANGE
G-10	IMPACT AREA
G-11	BATTLE INDOCTRINATION RANGE
G-13	MINIATURE ANTI-AIRCRAFT RANGE
G-14	TANK MACHINE GUN RANGE
I-4	DEMOLITION AREA
J-1	1000 INCH RANGE
J-2	1000 INCH RANGE
K-2	IMPACT AREA
L-2	IMPACT AREA
L-3	MACHINE GUN TRANSITION RANGE
L-4	1000 INCH RANGE
M-4	FIELD FIRING RANGE
N-1	IMPACT AREA

***NOTE: HISTORICAL MAP SHEET DATA USED IN THIS REPORT WAS RECTIFIED TO A CURRENT MAP PROVIDED BY MCB CAMP LEJEUNE USING INTERGRAPH CORPORATION SOFTWARE. THE ACCURACY OF FEATURES RECTIFIED FROM THE HISTORICAL MAP SHEET DATA TO THE CURRENT MCB CAMP LEJEUNE MAP MAY VARY.

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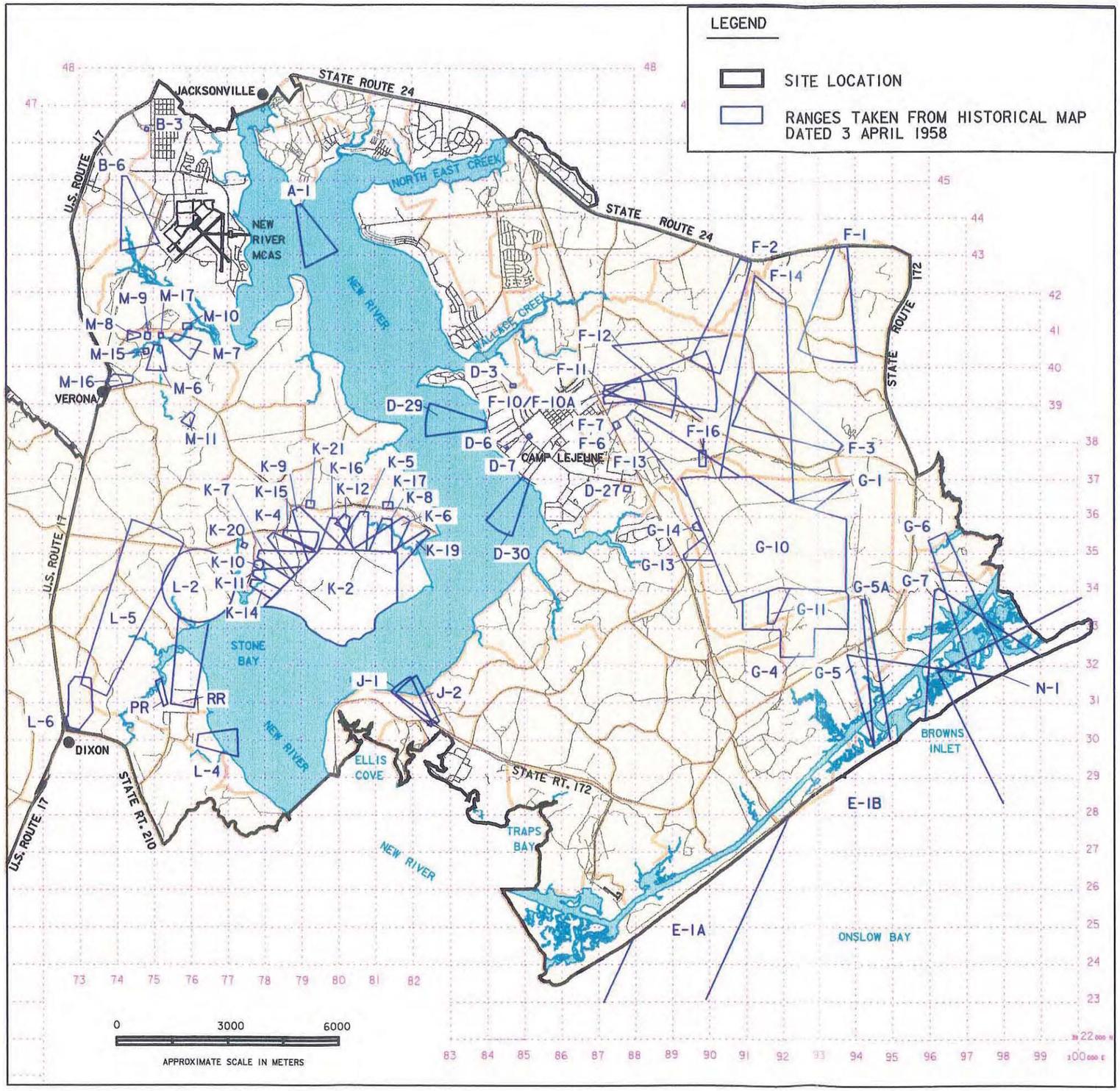
U.S. ARMY CORPS OF ENGINEERS
ST. LOUIS DISTRICT

MARINE CORPS BASE (MCB) CAMP LEJEUNE JACKSONVILLE, NORTH CAROLINA ONSLOW COUNTY RANGE OVERLAY MAP-JUNE 1954

PROJ. DATE: SEPT. 1999	DATE OF BASE MAP: 1998	PLATE NO. 8
15-FEB-2000 12:26	n:\ccw\northcarolina\lejeune\30june54.dgn	



KEY TO FEATURES:

FEATURE NUMBER	FEATURE DESCRIPTION
A-1	50 FOOT .22 CALIBER RANGE
B-3	GAS CHAMBER
B-6	50 FOOT SMALL ARMS RANGE
D-3	PRACTICE HAND GRENADE COURSE
D-6	50 FOOT INDOOR SMALL BORE RANGE
D-7	GAS CHAMBER
D-27	FORTIFIED BEACH ASSAULT AREA
D-29	50 FOOT SMALL BORE RANGE
D-30	50 FOOT SMALL BORE RANGE
E-1A	AAA AND ANTI-BOAT FIRING RANGE
E-1B	AAA AND ANTI-BOAT FIRING RANGE
F-1	FIELD FIRING RANGE
F-2	FIELD FIRING RANGE
F-3	FIELD FIRING RANGE
F-6	LIVE HAND GRENADE RANGE
F-7	.22 CALIBER RANGE, 1000 INCH
F-10	MACHINE GUN QUALIFICATION RANGE
F-10A	1000 INCH RANGE
F-11	PISTOL RANGE
F-12	FIELD FIRING RANGE
F-13	FIELD FIRING RANGE
F-14	FIELD FIRING RANGE
F-16	COMBAT VILLAGE
G-1	COMBAT RANGE
G-4	DEMOLITION ASSAULT AREA
G-5	ANTI-TANK RANGE
G-5A	MECHANIZED ANTI-TANK RANGE
G-6	ARTILLERY RANGE
G-7	DIRECT FIRE ARTILLERY RANGE
G-10	IMPACT AREA
G-11	BATTLE INDOCTRINATION COURSE
G-13	MINIATURE ANTI-AIRCRAFT RANGE
G-14	TANK MACHINE GUN RANGE
J-1	1000 INCH RANGE
J-2	1000 INCH RANGE
K-2	IMPACT AREA
K-4	TRANSITION FIRING RANGE
K-5	COMBAT FIRING RANGE
K-6	TRANSITION RANGE
K-7	COMBAT FIRING RANGE
K-8	CLOSE COMBAT COURSE
K-9	3.5 INCH ROCKET FIELD FIRING RANGE
K-10	RIFLE GRENADE FIELD FIRING RANGE
K-11	INFILTRATION COURSE
K-14	CLOSE COMBAT COURSE

KEY TO FEATURES:

FEATURE NUMBER	FEATURE DESCRIPTION
K-15	MACHINE GUN FIELD FIRING RANGE 500' AND 1000'
K-16	INFANTRY WEAPONS DEMONSTRATION RANGE
K-17	PRACTICE HAND GRENADE COURSE
K-19	300 YARD BATTLESIGHT RANGE
K-20	HAND GRENADE RANGE
K-21	FLAME THROWER RANGE
L-2	IMPACT AREA
L-4	1000 INCH RANGE
L-5	MULTI-PURPOSE MACHINE GUN RANGE
L-6	MINE WARFARE AND DEMOLITION AREA
M-6	INFILTRATION COURSE
M-7	LANDSCAPE RANGE
M-8	ASSAULT OF A FORTIFIED POSITION RANGE
M-9	COMBAT VILLAGE AREA
M-10	HAND GRENADE RANGE
M-11	ASSAULT OF A FORTIFIED POSITION AREA
M-15	MINE, BOOBYTRAP DISPLAY AREA
M-16	OUTDOOR CLASSROOM
M-17	PRACTICE HAND AND RIFLE GRENADE RANGE
N-1	IMPACT AREA
PR	PISTOL RANGE
RR	RIFLE RANGE

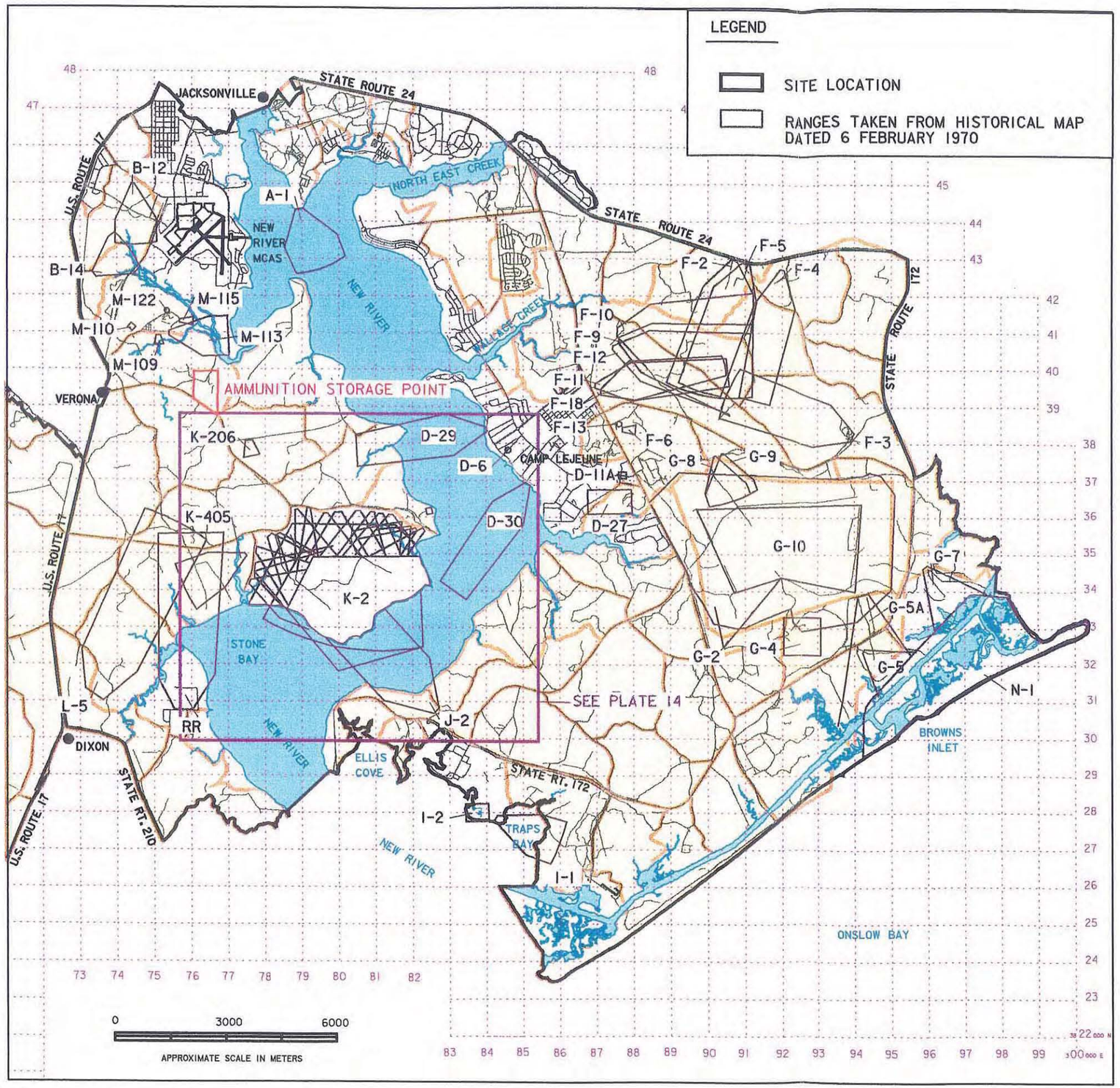
***NOTE: HISTORICAL MAP SHEET DATA USED IN THIS REPORT WAS RECTIFIED TO A CURRENT MAP PROVIDED BY MCB CAMP LEJEUNE USING INTERGRAPH CORPORATION SOFTWARE. THE ACCURACY OF FEATURES RECTIFIED FROM THE HISTORICAL MAP SHEET DATA TO THE CURRENT MCB CAMP LEJEUNE MAP MAY VARY.

N

U.S. ARMY CORPS OF ENGINEERS
ST. LOUIS DISTRICT

MARINE CORPS BASE (MCB) CAMP LEJEUNE JACKSONVILLE, NORTH CAROLINA ONSLOW COUNTY RANGE OVERLAY MAP-APRIL 1958

PROJ. DATE: SEPT. 1999	DATE OF BASE MAP: 1998	PLATE NO. 10
13-MAR-2000 08:30	n:\osw\northcarol\lejeune\3apr58r.dgn	



KEY TO FEATURES:

FEATURE NUMBER	FEATURE DESCRIPTION
A-1	PISTOL AND SHOTGUN RANGE
B-12	BAFFLED PISTOL RANGE
B-14	ASSAULT OF A FORTIFIED POSITION RANGE
D-6	50 FOOT INDOOR SMALL BORE RIFLE AND PISTOL RANGE
D-11A	FLAME TANK AND FLAME THROWER RANGE
D-27	FORTIFIED BEACH ASSAULT AREA
D-29	50 FOOT SMALL BORE RANGE
D-30	50 FOOT SMALL BORE RANGE
F-2	FIELD FIRING RANGE
F-3	FIELD FIRING RANGE
F-4	FIRE CONTROL RANGE
F-5	SQUAD LIVE FIRE AND MANEUVER COURSE
F-6	LIVE HAND GRENADE RANGE
F-9	BATTLE SIGHT RANGE
F-10	MACHINE GUN QUALIFICATION RANGE
F-11	PISTOL RANGE
F-12	FIELD FIRING RANGE
F-13	FLAME THROWER RANGE
F-18	MACHINE GUN FIELD FIRING RANGE
G-2	INFILTRATION RANGE
G-4	DEMOLITION ASSAULT COURSE
G-5	ANTI-TANK RANGE
G-5A	MECHANIZED ANTI-TANK RANGE
G-7	DIRECT FIRE ARTILLERY RANGE
G-8	GRENADE LAUNCHER RANGE
G-9	LIGHT ANTI-ARMOR WEAPONS AND SHOULDER LAUNCHED MULTI-PURPOSE ASSAULT WEAPONS RANGE
G-10	IMPACT AREA
I-1	50 FOOT SMALL BORE RANGE
I-2	DEMOLITION AREA
J-2	1000 INCH RANGE
K-2	IMPACT AREA - SEE NOTE BELOW
K-206	UNKNOWN RANGE
K-405	COMBAT PISTOL MARKMANSHIP RANGE
L-5	MULTI-PURPOSE MACHINE GUN RANGE
M-109	INFILTRATION RANGE
M-110	DEMOLITIONS AND BOOBY TRAP RANGE
M-113	HAND GRENADE RANGE (PRACTICE)
·	DEMONSTRATOR
M-115	HAND GRENADE RANGE
M-122	FLAME THROWER RANGE
N-1	IMPACT AREA
RR	RIFLE RANGE

***NOTE: SEE PLATE 14 FOR FEATURE NUMBERS AND FEATURE DESCRIPTIONS ON K RANGES.

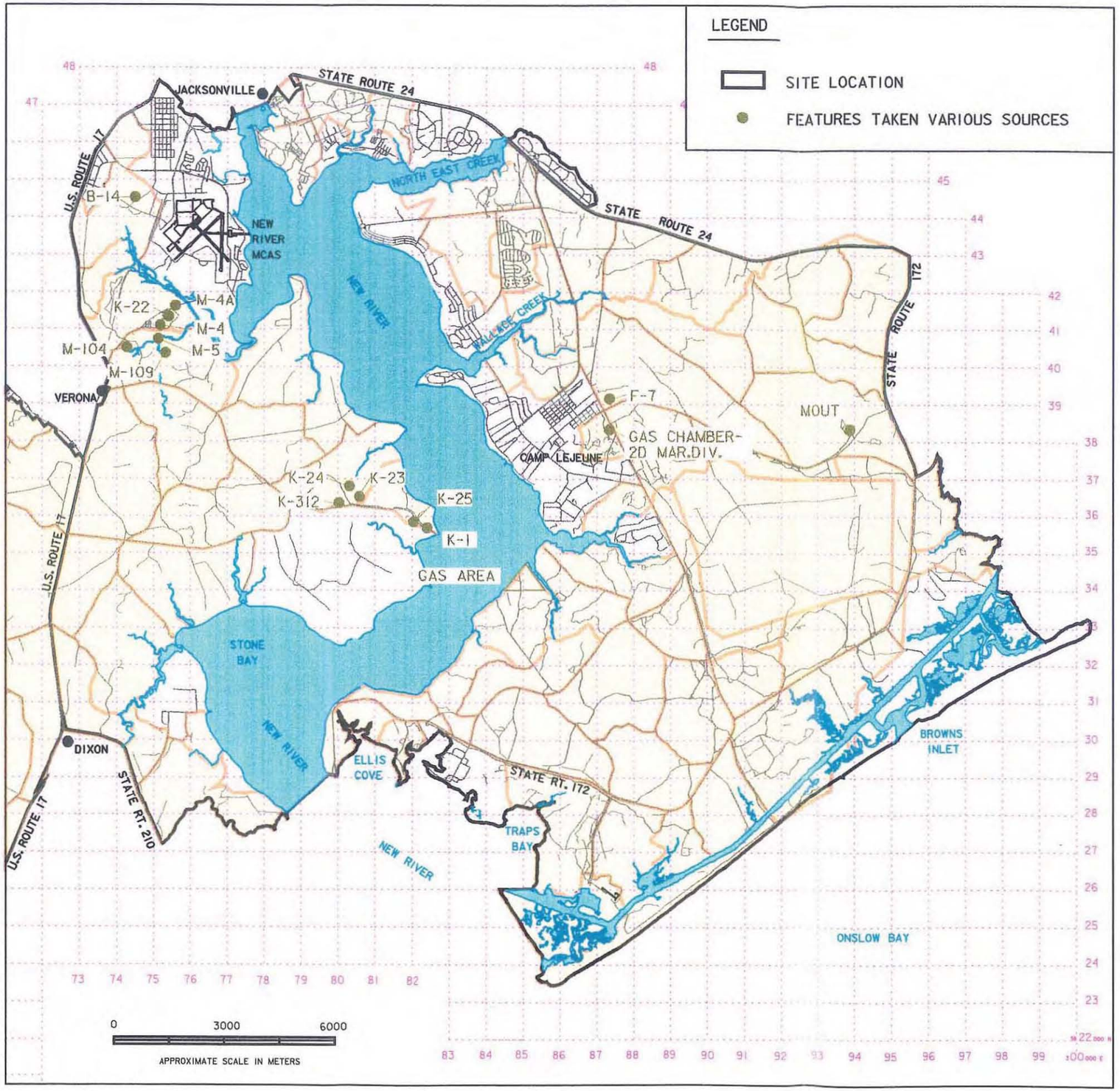
***NOTE: HISTORICAL MAP SHEET DATA USED IN THIS REPORT WAS RECTIFIED TO A CURRENT MAP PROVIDED BY MCB CAMP LEJEUNE USING INTERGRAPH CORPORATION SOFTWARE. THE ACCURACY OF FEATURES RECTIFIED FROM THE HISTORICAL MAP SHEET DATA TO THE CURRENT MCB CAMP LEJEUNE MAP MAY VARY.

N

U.S. ARMY CORPS OF ENGINEERS
ST. LOUIS DISTRICT

MARINE CORPS BASE (MCB) CAMP LEJEUNE JACKSONVILLE, NORTH CAROLINA ONSLOW COUNTY RANGE OVERLAY MAP-FEBRUARY 1970

PROJ. DATE: SEPT. 1999	DATE OF BASE MAP: 1998	PLATE NO. 13
15-FEB-2000 12:37	n:\gsw\northcarol\lejeune\65FEB70.DGN	



KEY TO FEATURES:

FEATURE NUMBER	FEATURE DESCRIPTION
K-24	DEMOLITION RANGE (1960)
K-25	ASSAULT OF A FORTIFIED POSITION RANGE (1960)
M-4	RIFLE GRENADE RANGE (1960)
M-5	PRACTICE RIFLE GRENADE RANGE (1960)
K-22	PRACTICE HAND GRENADE COURSE (1960)
K-23	GAS CHAMBER (1960)
M-4A	PRACTICE HAND GRENADE COURSE (1960)
K-1	81MM MORTAR FIELD FIRING RANGE (1960)
F-7	FLAME THROWER RANGE (1960)
M-104	DEMOLITIONS RANGE (1970)
M-109	INFILTRATION RANGE (1970)
MOUT	MOUT ASSAULT COURSE (1994)
B-14	ABC WARFARE AREA (1960)
GC	GAS CHAMBER (2D MAR. DIV.) (1970)
K-312	GAS CHAMBER (1970)
GAS AREA	GAS TRAINING AREA (1945)

***NOTE: THESE LOCATIONS ARE APPROXIMATE. NO PRECISE LOCATIONS WERE FOUND IN THE DOCUMENTATION.

***NOTE: HISTORICAL MAP SHEET DATA USED IN THIS REPORT WAS RECTIFIED TO A CURRENT MAP PROVIDED BY MCB CAMP LEJEUNE USING INTERGRAPH CORPORATION SOFTWARE. THE ACCURACY OF FEATURES RECTIFIED FROM THE HISTORICAL MAP SHEET DATA TO THE CURRENT MCB CAMP LEJEUNE MAP MAY VARY.

N

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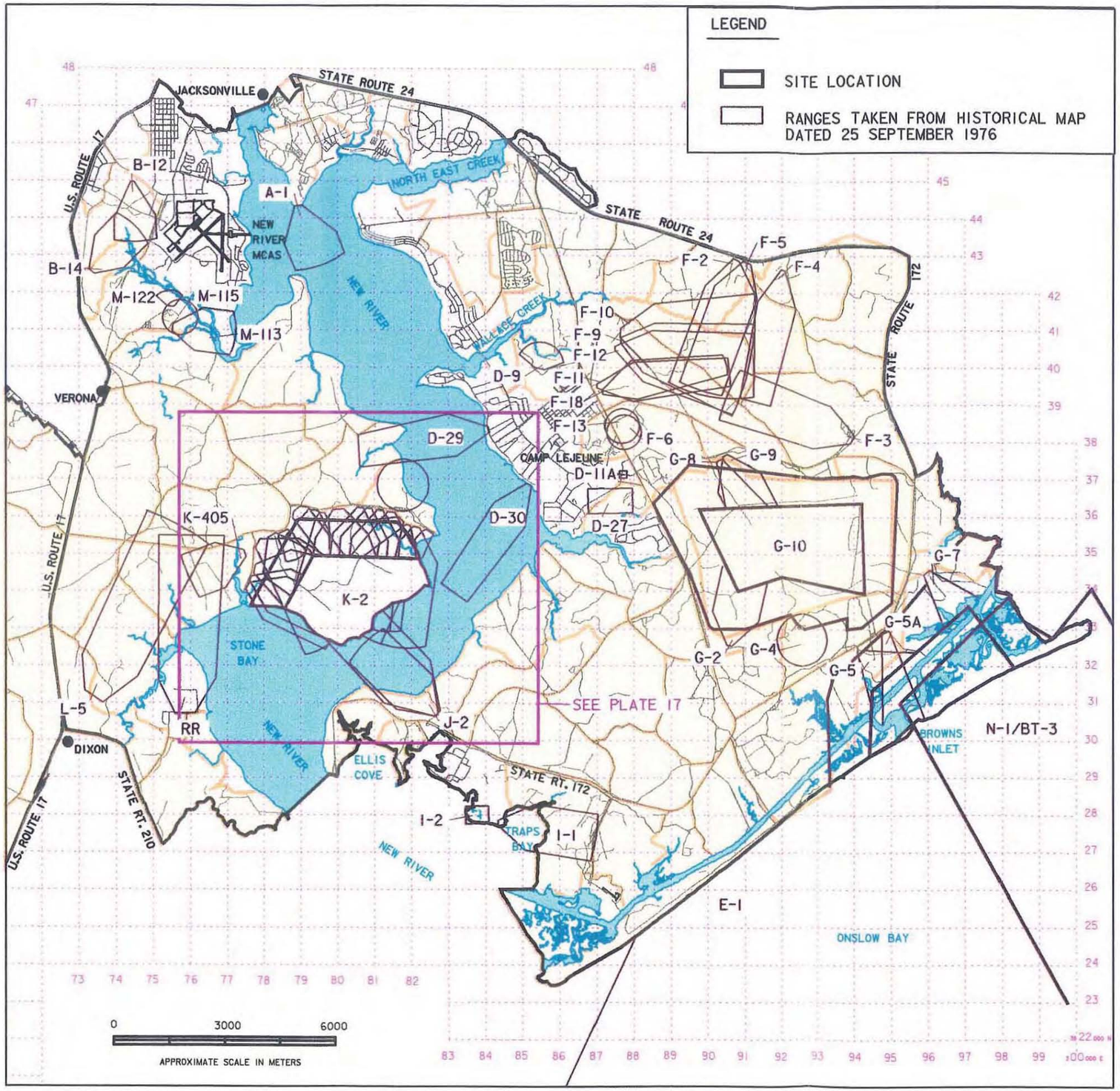
ST. LOUIS DISTRICT

MARINE CORPS BASE (MCB) CAMP LEJEUNE JACKSONVILLE, NORTH CAROLINA ONSLOW COUNTY MISCELLANEOUS RANGE FEATURES

PROJ. DATE: SEPT. 1999	DATE OF BASE MAP: 1998	PLATE NO. 15
10-MAR-2000 15:35	n:\cew\northcarol\lejeune\VARIOUS.DGN	



KEY TO FEATURES:

FEATURE NUMBER	FEATURE DESCRIPTION
A-1	PISTOL AND SHOTGUN RANGE
B-12	BAFFLED PISTOL RANGE
B-14	ASSAULT OF A FORTIFIED POSITION RANGE
D-9	SKEET RANGE
D-11A	FLAME TANK AND FLAME THROWER RANGE
D-27	FORTIFIED BEACH ASSAULT AREA
D-29	50 FOOT SMALL BORE RANGE
D-30	50 FOOT SMALL BORE RANGE
E-1	AIR DEFENSE FIRING RANGE
F-2	FIELD FIRING RANGE
F-3	FIELD FIRING RANGE
F-4	FIRE CONTROL RANGE
F-5	SQUAD LIVE FIRE AND MANEUVER COURSE
F-6	LIVE HAND GRENADE RANGE
F-9	BATTLE SIGHT RANGE
F-10	MACHINE GUN QUALIFICATION RANGE
F-11	PISTOL RANGE
F-12	FIELD FIRING RANGE
F-13	FLAME THROWER RANGE
F-18	MACHINE GUN FIELD FIRING RANGE
G-2	INFILTRATION RANGE
G-4	DEMOLITION ASSAULT COURSE
G-5	ANTI-TANK RANGE
G-5A	MECHANIZED ANTI-TANK RANGE
G-7	DIRECT FIRE ARTILLERY RANGE
G-8	GRENADE LAUNCHER RANGE
G-9	LIGHT ANTI-ARMOR WEAPONS AND SHOULDER LAUNCHED MULTI-PURPOSE ASSAULT WEAPONS RANGE
G-10	IMPACT AREA
I-1	50 FOOT SMALL BORE RANGE
I-2	DEMOLITION AREA
J-2	1000 INCH RANGE
K-2	IMPACT AREA - SEE NOTE BELOW
K-405	COMBAT PISTOL MARKMANSHIP RANGE
L-5	MULTI-PURPOSE MACHINE GUN RANGE
M-113	HAND GRENADE RANGE (PRACTICE) DEMONSTRATOR
M-115	HAND GRENADE RANGE
M-122	FLAME THROWER RANGE
N-1/BT-3	IMPACT AREA
RR	RIFLE RANGE

***NOTE: HISTORICAL MAP SHEET DATA USED IN THIS REPORT WAS RECTIFIED TO A CURRENT MAP PROVIDED BY MCB CAMP LEJEUNE USING INTERGRAPH CORPORATION SOFTWARE. THE ACCURACY OF FEATURES RECTIFIED FROM THE HISTORICAL MAP SHEET DATA TO THE CURRENT MCB CAMP LEJEUNE MAP MAY VARY.

***NOTE: SEE PLATE 17 FOR FEATURE NUMBERS AND FEATURE DESCRIPTIONS ON K RANGES.

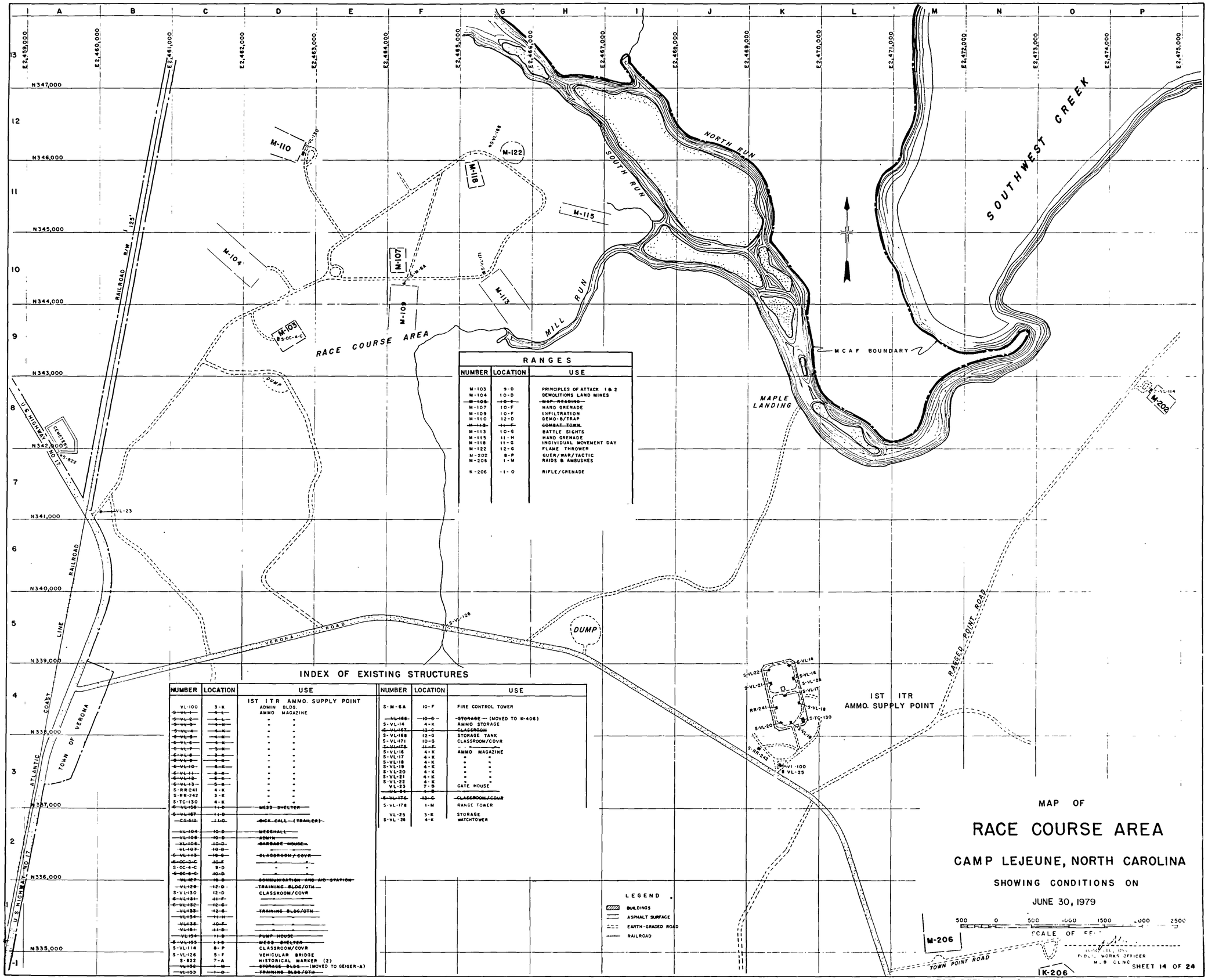
N

U.S. ARMY CORPS OF ENGINEERS
ST. LOUIS DISTRICT

MARINE CORPS BASE (MCB) CAMP LEJEUNE JACKSONVILLE, NORTH CAROLINA ONSLOW COUNTY RANGE OVERLAY MAP-SEPTEMBER 1976

PROJ. DATE: SEPT. 1999	DATE OF BASE MAP: 1998	PLATE NO. 16
10-MAR-2000 13:12	ru:\cew\northcarolinalejeune\255EP76.DGN	

Attachment 5
1979 Existing Conditions Map



RANGES

NUMBER	LOCATION	USE
M-103	9-D	PRINCIPLES OF ATTACK 1 & 2
M-104	10-D	DEMOLITIONS LAND MINES
~~M-105~~	~~10-E~~	~~MAP READING~~
M-107	10-F	HAND GRENADE
M-109	10-F	INFILTRATION
M-110	12-D	DEMO-B/TRAP
~~M-111~~	~~11-E~~	~~COMBAT TOWN~~
M-113	10-G	BATTLE SIGHTS
M-115	11-H	HAND GRENADE
M-118	11-G	INDIVIDUAL MOVEMENT DAY
M-122	12-G	FLAME THROWER
M-202	8-P	GUER/WAR/TACTIC
M-206	1-M	RAIDS & AMBUSHES
K-206	1-O	RIFLE/GRENADE

INDEX OF EXISTING STRUCTURES

NUMBER	LOCATION	USE
		IST ITR AMMO. SUPPLY POINT
VL-100	3-K	ADMIN BLDG.
~~S-VL-1~~	~~3-L~~	AMMO MAGAZINE
~~S-VL-2~~	~~3-L~~	" "
~~S-VL-3~~	~~3-M~~	" "
~~S-VL-4~~	~~3-M~~	" "
~~S-VL-5~~	~~3-M~~	" "
~~S-VL-6~~	~~3-N~~	" "
~~S-VL-7~~	~~3-N~~	" "
~~S-VL-8~~	~~3-N~~	" "
~~S-VL-9~~	~~3-N~~	" "
~~S-VL-10~~	~~3-N~~	" "
~~S-VL-11~~	~~3-N~~	" "
~~S-VL-12~~	~~3-N~~	" "
~~S-VL-13~~	~~3-N~~	" "
S-RR-241	4-K	" "
S-RR-242	3-K	" "
S-TC-130	4-K	" "
~~S-VL-158~~	~~11-D~~	~~MESS SHELTER~~
~~S-VL-167~~	~~11-D~~	" "
~~CG-512~~	~~11-D~~	~~DCK CALL (TRAILER)~~
~~VL-104~~	~~10-D~~	~~MESSHALL~~
~~VL-105~~	~~10-D~~	~~ADMIN~~
~~VL-106~~	~~10-D~~	~~GARBAGE HOUSE~~
~~VL-107~~	~~10-D~~	"
~~S-VL-113~~	~~10-G~~	~~CLASSROOM / COVR~~
~~S-OC-3-C~~	~~10-E~~	" "
S-OC-4-C	9-D	" "
~~S-OC-5-C~~	~~10-D~~	" "
~~VL-107~~	~~10-D~~	~~COMMUNICATION AND AID STATION~~
~~VL-120~~	~~12-D~~	~~TRAINING BLDG/OTH~~
S-VL-130	12-D	CLASSROOM/COVR
~~S-VL-131~~	~~11-F~~	" "
~~S-VL-132~~	~~12-G~~	" "
~~VL-133~~	~~12-G~~	~~TRAINING BLDG/OTH~~
~~VL-134~~	~~11-D~~	" "
~~VL-135~~	~~10-F~~	" "
~~VL-151~~	~~11-D~~	" "
~~VL-154~~	~~11-D~~	~~PUMP HOUSE~~
~~S-VL-155~~	~~11-D~~	~~MESS SHELTER~~
S-VL-114	8-P	CLASSROOM/COVR
S-VL-126	5-F	VEHICULAR BRIDGE
S-822	7-A	HISTORICAL MARKER (2)
~~VL-150~~	~~1-N~~	~~STORAGE BLDG — (MOVED TO GEIGER-A)~~
~~VL-153~~	~~1-O~~	~~TRAINING BLDG/OTH~~

NUMBER	LOCATION	USE
S-M-6A	10-F	FIRE CONTROL TOWER
~~VL-166~~	~~10-G~~	~~STORAGE — (MOVED TO K-406)~~
S-VL-14	4-K	AMMO STORAGE
~~S-VL-167~~	~~12-G~~	~~CLASSROOM~~
S-VL-168	12-G	STORAGE TANK
S-VL-171	10-G	CLASSROOM/COVR
~~S-VL-175~~	~~11-E~~	" "
S-VL-16	4-K	AMMO MAGAZINE
S-VL-17	4-K	" "
S-VL-18	4-K	" "
S-VL-19	4-K	" "
S-VL-20	4-K	" "
S-VL-21	4-K	" "
S-VL-22	4-K	" "
VL-23	7-B	GATE HOUSE
~~VL-24~~	~~7-B~~	" "
~~S-VL-176~~	~~12-G~~	~~CLASSROOM/COVR~~
S-VL-178	1-M	RANGE TOWER
VL-25	3-K	STORAGE
S-VL-26	4-K	WATCHTOWER

LEGEND
- BUILDINGS
- ASPHALT SURFACE
- EARTH-GRADED ROAD
- RAILROAD

MAP OF
RACE COURSE AREA
CAMP LEJEUNE, NORTH CAROLINA
SHOWING CONDITIONS ON
JUNE 30, 1979

500 0 500 1000 1500 2000 2500
SCALE OF FEET

PUBLIC WORKS OFFICER
M-B CLNC

CAMP LEJEUNE, N.C.

Appendix B
Soil Boring Logs and Well Completion Diagrams

Boring Number: VL-MW01

Client: NAVFAC Mid-Atlantic
Project: UXO 25 - Verona Loop PA/SI
Location: MCIEAST - MCB CAMLEJ
Project Number: 424500.SI.SI

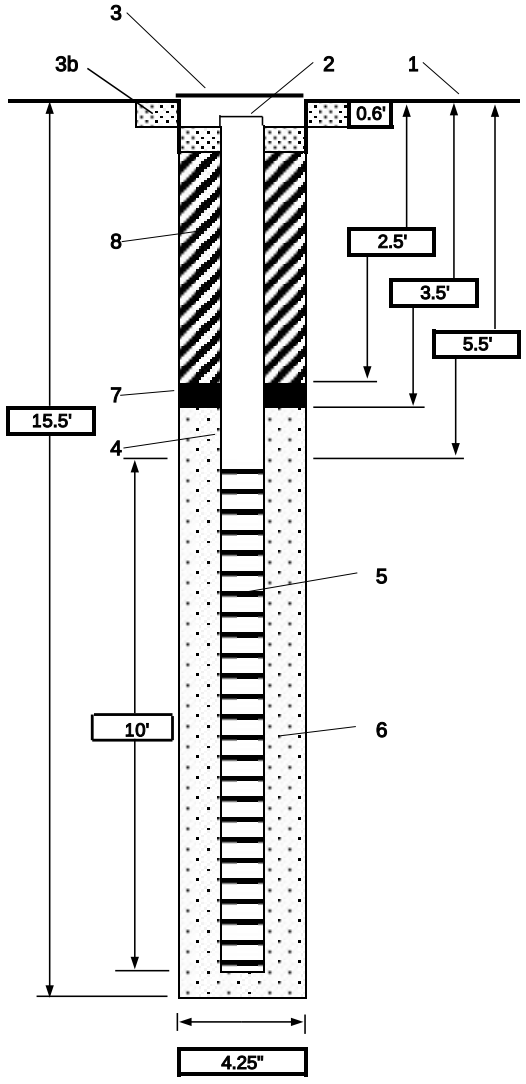
Driller: Mid Atlantic Drilling
Drilling Method: Hollow Stem Auger
Sampling Method: Macro Core
Logged by: J.Crostic
Start/Finish Date: 4/24/12

Depth (ft)	Sample Information: Sample Type	Recovery (%)	PID (ppm)	Soil Log	Soil Description	Depth / Elev (ft)	Comments
					Ground Surface	0	
0	DP-1	87	0		**Silty sand (SM)** Dark brown, dry,organic, loose, coarse.	0 -1	
					Silty sand (SM) Dark orange, dry, dense.	1	
					Sand (SP) Light tan, dense, fine grained.	-3 3	
					Sand (SP) Dark black, slightly moist, fine grained.	-5	
5	DP-2	96	0		**Sand (SP)** Tan, moist, fine grained.	5 -6	
					Clayey silt (ML) Tan, very moist, loose, with some clay.	6 -8	Water Table at 7 feet
	DP-3	100	0		**Clayey sand (SC)** Light tan, wet, slightly dense, with some clay.	8 -11	
10					**Sandy clay (CL)** Dark gray, wet, dense, fine grained.	11	
	DP-4	100	0			-16	
15					End of Log	16	
20							

PROJECT NUMBER	WELL NUMBER		
424500.SI.SI	VL-MW01	SHEET 1	OF 1

WELL COMPLETION DIAGRAM

PROJECT : Site UXO-25 - Verona Loop PA/SI
LOCATION : Verona, North Carolina - MCIEAST-MCB CAMLEJ
DRILLING CONTRACTOR : Mid Atlantic Drilling
DRILLING METHOD AND EQUIPMENT USED : Hollow Stem Auger
WATER LEVELS : 5.17 feet bgs START : 4/24/2012 15:35 END : 4/24/12 16:30 LOGGER : JCrostic/CLT



1- Ground elevation at well	60.17	feet mean sea level
2- Top of casing elevation	63.25	feet mean sea level
3- Wellhead protection cover type	concrete bollards at each corner of pad	
a) drain tube?	No	
b) concrete pad dimensions	2-ft x 2-ft x 4-inch	
4- Dia./type of well casing	2"/PVC	
5- Type/slot size of screen	0.0010 inch slot size	
6- Type screen filter	30/40 silica sand (50 pound bags)	
a) Quantity used	5.5 bags	
7- Type of seal	Bentonite	
a) Quantity used	1/2 bag	
8- Grout		
a) Grout mix used	Portland cement-Bentonite mix	
b) Method of placement	Tremie pipe	
c) Vol. of well casing grout	2	gallons
Development method	Surging/overpumping	
Development time	2 hours	
Estimated development volume	30 gallons	
Comments:		

Boring Number: VL-MW02

Client: NAVFAC Mid-Atlantic
Project: UXO 25 - Verona Loop PA/SI
Location: MCIEAST - MCB CAMLEJ
Project Number: 424500.SI.SI

Driller: Mid Atlantic Drilling
Drilling Method: Hollow Stem Auger
Sampling Method: Macro Core
Logged by: J. Crostic
Start/Finish Date: 4/24/12

Depth (ft)	Sample Information: Sample Type	Sample Information: Recovery (%)	Sample Information: PID (ppm)	Soil Log	Soil Description	Depth / Elev (ft)	Comments
					Ground Surface	0	
0	DP-1	88	0		**Silty sand (SM)** Dark brown, dry, medium dense.	0 -1	
					Silty sand (SM) Light brown, slightly moist, medium dense sand.	1 -4	
5	DP-2	92	0		**Clayey Sand (SC)** Dark brown to black, slightly moist, medium soft.	4 -6	
					Sandy clay (CL) Dark gray, moist, medium soft.	6	Water Table at 9 feet
10	DP-3	100	0				
	DP-4	100	0				
15	DP-5	100	0			-18	
					End of Log	18	
20							

PROJECT NUMBER	WELL NUMBER		
424500.SI.SI	VL-MW02	SHEET 1	OF 1

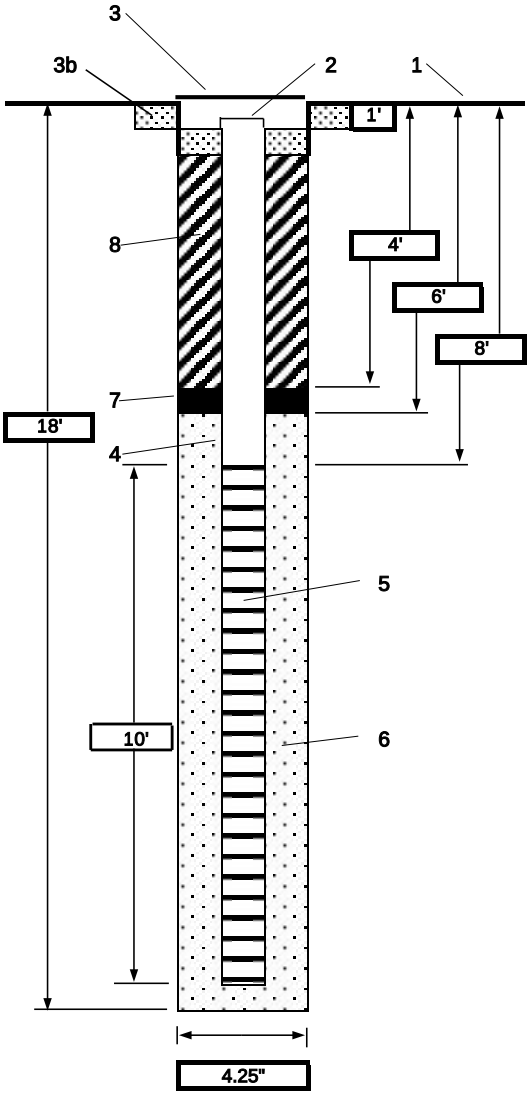
WELL COMPLETION DIAGRAM

PROJECT : Site UXO-25 - Verona Loop PA/SI LOCATION : Verona, North Carolina - MCIEAST-MCB CAMLEJ

DRILLING CONTRACTOR : Mid Atlantic Drilling

DRILLING METHOD AND EQUIPMENT USED : Hollow Stem Auger

WATER LEVELS : 6.02 feet bgs START : 4/24/2012 11:15 END : 4/24/12 14:30 LOGGER : JCrostic/CLT



1- Ground elevation at well: 51.77 feet mean sea level

2- Top of casing elevation: 55.35 feet mean sea level

3- Wellhead protection cover type: Steel protective stickup cover and four concrete bollards at each corner of pad

a) drain tube? No

b) concrete pad dimensions: 2-ft x 2-ft x 4-inch

4- Dia./type of well casing: 2"/PVC

5- Type/slot size of screen: 0.0010 inch slot size

6- Type screen filter: 30/40 silica sand (50 pound bags)

a) Quantity used: 6.5 bags

7- Type of seal: 3/8" Bentonite (50 pound bags)

a) Quantity used: 3/4 bag

8- Grout

a) Grout mix used: Portland cement-Bentonite mix

b) Method of placement: Tremie pipe

c) Vol. of well casing grout: 7 gallons

Development method: Surging/overpumping

Development time: 30 minutes

Estimated development volume: 15 gallons

Comments:

Appendix C
Non-Hazardous Shipping Manifest

Clearfield MMG

Post Office Box 1444
Chesapeake, VA 23327
(757) 549-8448
FAX: (757) 549-6668

NON-HAZARDOUS SHIPPING MANIFEST

MANIFEST NO. 2-2614

GENERATOR

NAME **Marine Corps Air Station (MCAS), New River** TELEPHONE **910-451-9385**

ADDRESS **PSC Box 20004; Attn: I&E/EMD/ECB/RCRS** CITY **Camp Lejeune** STATE **NC**

SHIPMENT ORIGIN **Waste Staging Area off Michael Rd. Marine Corps Base Camp Lejeune** CITY **Camp Lejeune** STATE **NC**

AUTHORIZED AGENT **Charity Rychak** FIRM **MCB Camp Lejeune**

ADDRESS OTHER **CTOWE15-JP5-W01 CH2M HILL Project # 425128**

MATERIAL CHARACTERIZATION

ACTIVITY GENERATING THIS MATERIAL: UST/AST REMOVAL _____ OTHER **IDW at JP-5 Pipeline**

PETROLEUM TYPE (S): **JP-5** VIRGIN PRODUCT **X** NON-VIRGIN PRODUCT _____

PHYSICAL STATE: STOCKPILED _____ EXCAVATING _____ DRUMS **1** OTHER _____

(1 Water)

HANDLING INSTRUCTIONS: **Transport To Facility Designated Below**

FIRE OR SPILL INSTRCUTIONS: **Non-Flammable / Non-Hazardous**

DESTINATION: **Chesapeake Facility**

I hereby certify, to the best of my knowledge, the material characterized above is non-hazardous as defined by the Virginia Hazardous Waste Management Regulations, Federal Regulations under Subtitle C - RCRA, U.S. Department of Transportation, or local / state of origin regulations.

Signature of Generator / Agent

Printed Name / Date 11/28/12

TRANSPORTER

TRANSPORTER NAME **Clearfield MMG, Inc.** TELEPHONE **757-549-8448** TRUCK NO. **14**

I certify that the materials described above were received by me for shipment and delivered to the designated facility.

Transporter Signature / Date 11-29-12

FACILTIY

I certify that the materials described above were delivered to the facility and received by me.

ACCEPTED BY _____ DATE 11/29/12

REASONS FOR REJECTION _____

Gross Weight
Tare Weight
Net Weight
Tons

FACILITY

Appendix D
Geophysical Investigation Report

MCIEAST-MCIEAST-MCB CAMLEJ UXO-25 DGM Final Report

PREPARED FOR: Dan Hockett/CLT

COPY TO: Tamir Klaff/WDC; Andy Gascho/DEN; Jennifer Weller/DFB; Andrew Louder/WDC; Jessica High/CLT

PREPARED BY: Matthew Barner/CLT

DATE: October 9, 2012

PROJECT NUMBER: 424500

This memorandum presents the results of digital geophysical mapping (DGM) conducted by CH2M HILL at Site UXO-25 at Marine Corps Base Lejeune (MCIEAST-MCB CAMLEJ) in Jacksonville, North Carolina. The DGM was conducted in support of a Preliminary Assessment/Site Inspection (PA/SI). Work was performed by CH2M HILL under Navy CLEAN Contract N62470-08-D-1000, Contract Task Order (CTO) WE18.

Survey Objective

The objective of the DGM was to identify subsurface anomalies potentially indicative of Munitions and Explosives of Concern (MEC) within the PA/SI investigation area.

Site Description

The PA/SI investigation area at UXO-25 consists of approximately 25 acres, divided into two sections. The investigation area is outlined in yellow on **Figure 1** and consists of a northern and southern area. The DGM survey was conducted along individual transects that comprised approximately 2.5 acres of coverage of the 25-acre PA/SI investigation area. The transects are shown in red on **Figure 1** and were located between Old US Route 17 and US 17 North near the town of Verona, North Carolina.

The DGM survey area encompasses a former Maneuver Training Area and Impact Area (also referred to as Area M) and a portion of a former M-16 Outdoor Classroom. Area M was reportedly used between 1941 and 1945. According to the Range Identification and Preliminary Range Assessment for MCIEAST-MCB CAMLEJ (USACE, 2001), the area appears on a map dated August 20, 1941. The M-16 Outdoor Classroom appears on a range map dated April 3, 1958. Little information is available on the history of this area and period of use other than that it appears on a 1958 range map.

The Range Identification and Preliminary Range Assessment for MCIEAST-MCB CAMLEJ (USACE, 2001) indicates that Live Fire and Maneuver Exercises were conducted in Area M, and the use of mortars, recoilless rifles, 2.36-inch rockets and hand and rifle grenades is possible within this area. Specifically, the following munitions are listed in the Preliminary Range Assessment for Area M: Hand Grenades (all types), Rifle Grenades (all types), 60mm Mortar, 81mm Mortar, 37mm Gun, 40mm Gun, 75mm Howitzer, 105mm Howitzer, 155mm Howitzer and Gun, 57mm Recoilless Rifle, 75mm Recoilless Rifle, 90mm Recoilless Rifle, 2.36-inch Rocket (HEAT and Practice). Blank small arms ammunition and pyrotechnics were reportedly used at the M-16 Outdoor Classroom.

The DGM survey area at UXO-25 was densely wooded. Brush clearing was performed along the proposed transects in order to provide access for the DGM equipment. Ground cover vegetation and trees smaller than 6 inches in diameter were cut to a height of approximately 6 inches above ground surface. An overgrown drainage ditch bisected the southern area, which resulted in a data gap (**Figure 1**). Additional data gaps resulted from large logs that lay across transects and were not removed during vegetation clearance. Power lines extending parallel to and within the eastern right-of-way of Old US Route 17 appeared to impact the geophysical equipment along the western margin of the northern and southern survey areas.

Health and Safety

The DGM at Site UXO-25 was conducted in accordance with the project Health and Safety Plan (HASP). Upon arrival to the site, CH2M HILL DGM personnel received a site-specific orientation from the unexploded ordnance quality control/safety officer (UXOQC/SO). The UXOQC/SO subsequently provided daily safety briefings each morning.

Geophysical Equipment

In accordance with the project Geophysical Investigation Plan (GIP) (CH2M HILL, 2011), the Geonics Ltd. EM61-MK2 instrument was presumptively-selected and used to conduct the DGM at Site UXO-25. An Allegro CX field computer was used to operate the system and for data storage.

The EM61-MK2 is a high-resolution, time-domain electromagnetic instrument designed to detect, with high spatial resolution, shallow ferrous and non-ferrous metallic objects. The standard EM61-MK2 system consists of two air-cored, 1-meter (m) by 0.5-m coils, a digital data recorder, batteries and operating electronics. The EM61-MK2 transmitter generates a pulsed primary magnetic field, which induces eddy currents in nearby metallic objects.

For the DGM at UXO-25, the EM61-MK2 was operated in four-channel mode. In this mode, the system measures the eddy currents at four distinct time intervals recorded by the bottom coil. The four-channel mode of operation was used at Site UXO-25, and is generally used in DGM operations, because responses from potential surface and near-surface items are desired. In addition, the fourth interval from the bottom coil provides data that enhances evaluation of response decay over suspected individual MEC items. In this mode, earlier time gates provide enhanced detection of smaller metallic objects.

The EM61-MK2 was operated in person-portable mode with the system mounted on its standard wheels. In this mode, the bottom coil measured approximately 42 centimeters (cm) above the ground surface. The system consisted of encapsulated coils, which resulted in a height of 42 cm as opposed to the 40 cm height of the standard EM61-MK2 coil.

Positioning of the EM61-MK2 was maintained using fiducial markers inserted in the data at staked intervals along each transect. Because data were collected in four-channel mode, the top coil of the EM61-MK2 was not utilized. During project planning, CH2M HILL assumed that the majority of Site UXO-25 would not be conducive to the reliable use of GPS because of the tree canopy.

Mobilization

CH2M HILL DGM personnel mobilized to the Jacksonville, North Carolina area on April 29, 2012. Field work was first conducted at another project site at MCIEAST-MCB CAMLEJ. The field work was conducted at UXO-25 on May 3 and 4, 2012.

Geophysical System Verification

CH2M HILL implemented the Geophysical System Verification (GSV) process for the DGM at Site UXO-25. This process compares signal strength and sensor performance to known response curves of industry standard objects (ISOs) to validate DGM systems before and during site surveys. The GSV process, the Measurement Quality Objectives (MQOs) and Measurement Performance Criteria (MPC) are discussed in detail in the GSV Plan, which is included as Attachment 1 to the GIP (CH2M HILL, 2011).

CH2M HILL elected to use an IVS that had been previously constructed in January 2012 for the DGM at Site UXO-26 at the Marine Corps Air Station (MCAS) New River. There was relatively minimal suitable, uncleared land around the UXO-25 survey area for an IVS. In addition, noise from the power lines essentially prevented the establishment of an IVS within the vicinity of Old US Route 17. The IVS at UXO-26 was located within a 10-minute drive of UXO-25.

CH2M HILL first verified that the UXO-26 IVS was intact, the buried seed items had remained undisturbed, and that the site conditions at the IVS were suitable for continued use. CH2M HILL modified the IVS for the UXO-25 DGM, removing the middle seed item (ISO-2) from the original IVS. The item removed was a small ISO oriented

horizontal and along the seeded IVS transect. The resulting IVS used for UXO-25 contained two small ISOs. The original ISO-3 location was renamed to ISO-2 for the UXO-25 DGM.

Initial testing was conducted along the IVS transects to verify that the along-transect distances were accurately tracked by the EM61-MK2 wheel encoder. The IVS data collected for the UXO-25 DGM were submitted on April 30, 2012 to the CH2M HILL Quality Control (QC) Geophysicist for evaluation. The same IVS was used for the separate DGM survey conducted prior to UXO-25. Because the field team and EM61-MK2 system remained unchanged for both projects, the IVS results collected on April 30, 2012, were used to validate the system for the DGM at UXO-25.

As part of the on-going GSV process, four blind seed items were buried by the UXOQC/SO within the DGM survey area, and the locations were recorded by the project land surveying subcontractor, ECLS. The locations of the seed items were not marked in the field and were sent directly to the QC Geophysicist. The IVS construction details and results of the GSV process for UXO-25 are presented as **Attachment A** to this memorandum. The initial IVS construction details and results of the UXO-26 GSV process can be found in Attachment A of the *MCB Camlej UXO-26 DGM Final Report* (CH2M HILL, 2012).

DGM Field Investigation

Prior to the start of the DGM at UXO-25, ECLS placed wooden stakes along each transect at a spacing of 82 feet (25 meters) or less. ECLS recorded the unique IDs on each stake. The individual stake locations are depicted as orange circles and transect IDs are displayed in red on **Figures 2 and 3**. The MCIEAST-MCB CAMLEJ base-wide grid network is also presented on these figures for general reference.

DGM data were collected with a single 1-meter wide (i.e. width of coil) pass of the EM61-MK2 along each transect, where the DGM field crew attempted to maintain the straight-line path from one stake to the next. Fiducial markers were added in the data when the center of the EM61-MK2 passed over each stake. Representative photos of the DGM field work are presented as **Figure 4.** Using the known surveyed coordinates of the stakes and the fiducial markers, the DGM data were able to be georeferenced during data processing to Universal Transverse Mercator (UTM) coordinates. CH2M HILL utilized a Munitions Response Site Information Management System (MRSIMS) personal digital assistant (PDA) to record the start and end stake IDs for each transect. The PDA was also used to track the locations of impassable obstructions (e.g. drainage ditch). This information was submitted each day along with the raw DGM data to the CH2M HILL data processor.

Daily QC tests were conducted in accordance with the GIP and included an instrument warm-up period, static test measurements of background values and response values with a small ISO, collection of the seeded IVS transect, and collection of repeat data profiles. Descriptions of the QC tests and MQOs for each are included in the GIP (CH2M HILL, 2011). Additional field information (e.g. QC test file names, weather conditions, general survey notes) was recorded using the MRSIMS PDA.

Figure 4. DGM at UXO-25
Left: Conducting Daily QC Tests at IVS
Middle: Positioning EM61-MK2 Over a Stake
Right: Collecting EM61-MK2 Transect Data



Information Management

Raw data, field information, photos and other relevant supporting field notes were posted daily to the project file transfer protocol (FTP) site. The MRSIMS PDA was synchronized daily with the master MRSIMS project database stored on the project ftp site. Data and field information collected during the DGM is provided on the CD included with this report.

Demobilization

The field team demobilized from the Jacksonville, North Carolina area on May 4, 2012.

Data Processing

Data processing was completed in the following steps: QC review of DGM field forms, fiducial positioning, DGM pre-processing, and DGM final processing.

QC of DGM Field Forms

Daily QC of the DGM field forms was completed by the CH2M HILL Data Processor. This QC process was intended to check that MRSIMS was updated each day with the required information and that the relevant field information (e.g. survey notes, QC test file names, EM61-MK2 battery levels, weather conditions, etc.) was effectively captured.

Fiducial Positioning

Raw EM61-MK2 data files were imported into DAT61MK2 (issued by Geonics, Ltd.), where the individual transect start, end and internal fiducial markers were manually entered or adjusted by the Data Processor. The software interpolated between the points along each transect to refine the local (X,Y) coordinates for each measurement. The resulting files were subsequently exported as .XYZ files in the American Standard Code for Information Interchange Two (ASCII) format. These .XYZ files contained the adjusted positions, the sensor responses for each of the four channels and the corresponding time stamp.

DGM Pre-Processing

Positioned .XYZ files were subsequently imported into Oasis Montaj (issued by Geosoft) for pre-processing. DGM pre-processing steps included the following:

- Evaluate QC tests (static, cable shake and personnel) prior to processing DGM survey data;
- Conversion/warping of the local (X,Y) coordinate system to NAD83 UTM Zone 18 North coordinates (meters) by matching fiducial marker locations with surveyed stake locations provided by ECLS;
- Application of auto leveling and instrument drift corrections for EM61-MK2 data;
- Application of an appropriate lag correction (from daily seeded IVS transect collection);
- Gridding of all four time gates using the Oasis Montaj minimum curvature algorithm;
- Generation of preliminary contour maps from gridded data;
- Preliminary comparison of original versus repeat data;
- Generation of formatted ASCII files containing preprocessed data for UXO-26.

Following completion of the above steps, the pre-processed data were reviewed by the CH2M HILL QC Geophysicist. Once approved by the QC Geophysicist, a Raw Data Delivery report was generated from MRSIMS.

DGM Final Processing

Final DGM processing steps included the following:

- Target selection from contoured data for each UXO-24 survey grid;
- Generation of formatted ASCII files containing processed data;
- Generation of a final map for UXO-24 grids showing contoured, gridded data, target locations, surveyor stake locations, and anomaly polygons;
- Preparation of target lists.

Following completion of the above steps, the final processed data were reviewed by the CH2M HILL QC Geophysicist. Once approved by the QC Geophysicist, a Final Data Delivery report was generated from MRSIMS.

Target Selection

The target anomaly threshold of 3 milliVolts (mV) on Channel 2 was selected for UXO-25. The GSV report (**Attachment A**) provides additional information on these selection criteria based on the IVS survey results and DGM objectives for UXO-25. Initial target selections were made using the automatic peak picking module (Blakely Test) in the Oasis Montaj UX-Detect module to identify peak amplitude responses in the gridded Channel 2 data that appeared to be indicative of potential MEC. Data profiles for all four channels were reviewed by the Data Processor to evaluate the validity and position of the auto-selected targets. Targets found to be invalid or incorrectly located were adjusted and/or removed from the final selection list. This review was performed by evaluating the decay in mV responses laterally from a peak response as well as the general shapes of the response curves for each channel at the selected anomaly locations. The intent of this evaluation was to identify automatically-selected targets that appear to be associated with surface debris or noise spikes. These anomalies typically exhibit different characteristics compared to subsurface anomalies potentially indicative of MEC. This review process also facilitates adding anomalies to the target selection list that may not have been automatically selected by the UX-Detect module but appear to represent potential MEC.

Targets identified as Type 1 in the final anomaly list are those characteristic of potential MEC (see **Table 1**). Target lists were generated for each transect and were provided to the QC Geophysicist for approval as part of the DGM Final Processing package.

Table 1. Representative Selection of Type 1 Targets for UXO-25

ID	GRIDCELLID	X1	Y1	X2	Y2	X3	Y3	X4	Y4	TYPE	AMPLITUDE	UNITS
1	B	273682.60	3839457.20	0	0	0	0	0	0	1	77.5	mv
2	B	273688.60	3839468.80	0	0	0	0	0	0	1	5.5	mv
3	B	273688.80	3839470.80	0	0	0	0	0	0	1	7.0	mv
4	B	273692.40	3839497.00	0	0	0	0	0	0	1	9.8	mv
5	B	273692.82	3839504.70	0	0	0	0	0	0	1	12.7	mv

DGM Results

The results of the DGM at Site UXO-25 are presented as **Figures 2 and 3**. These figures depict the UXO-25 northern and southern area results, respectively. Responses between 0 and 3 mV represent localized background conditions. A total of 904 targets were selected from the DGM data, but of these, 361 were identified as Type 1 targets along the transects. The remainder of the targets appeared to be associated with noise from the power lines along Old US Route 17 or surface metal. Four of the Type 1 targets represent the QC seed locations that were successfully detected as part of the GSV process (see **Attachment A**).

Type 1 targets are identified as red triangles in **Figures 2 and 3**. The corresponding target IDs shown in **Figures 2 and 3** correspond to the IDs on the supplied target lists (see **Table 1**). These IDs start with "1" for both the northern and southern areas. The Type 1 targets were reviewed by the CH2M HILL QC Geophysicist and assigned for re-acquisition and intrusive investigation in MRSIMS. Upon import into MRSIMS, each target was given a

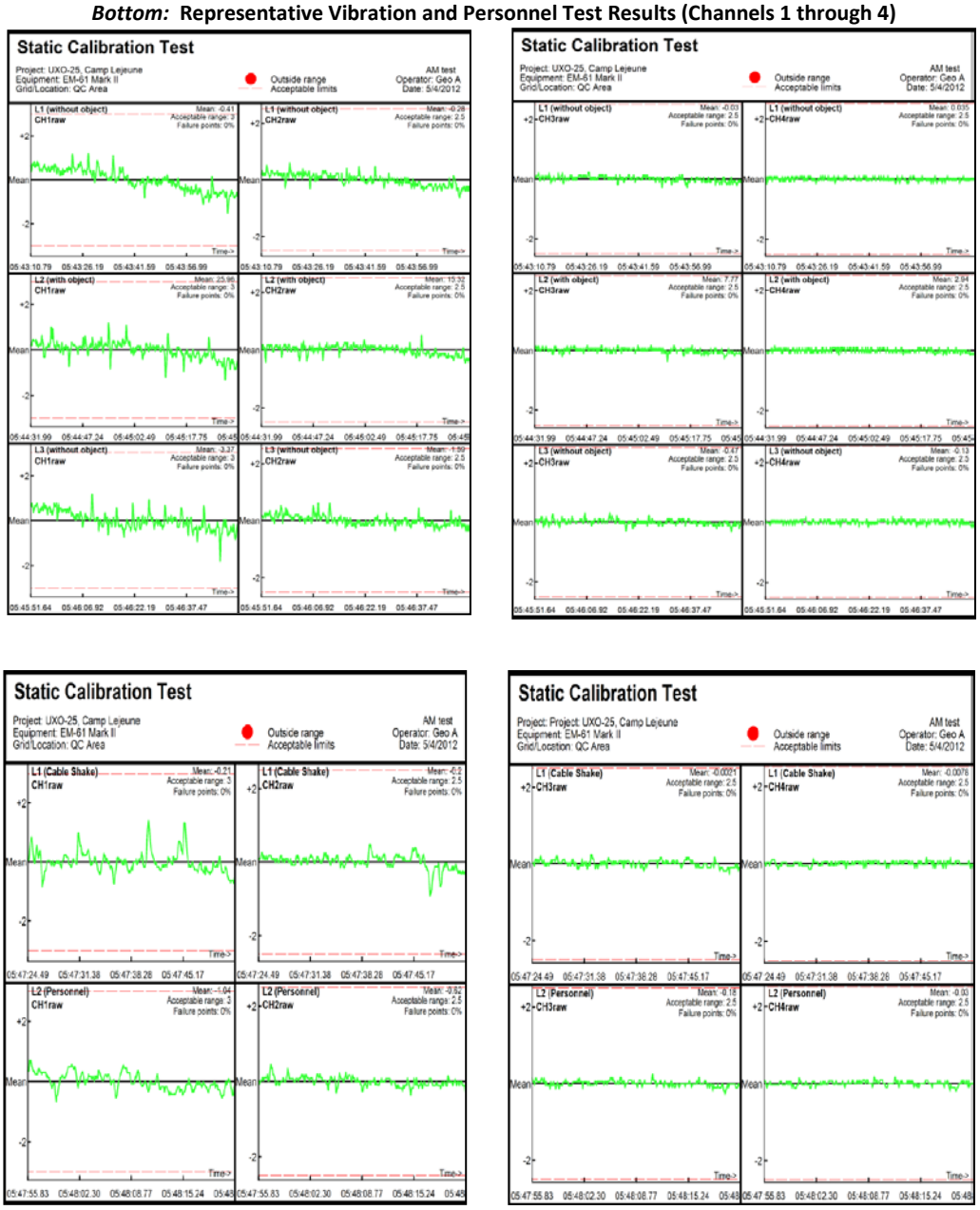
unique ID that combines the transect ID and target ID. This unique ID will remain with the target for the duration of the PA/SI.

The MQOs for the quantitative QC tests (cable shake, personnel, static) were met for the DGM at Site UXO-25. Sample results of the QC tests are presented as **Figure 5**. The remainder of the test results, along with the Raw Data Delivery and Final Data Delivery Reports, are provided on the CD included with this report.

Figure 5. Representative DGM QC Test Results for UXO-25

Top: **Representative Static Test Results (Channels 1 through 4)**

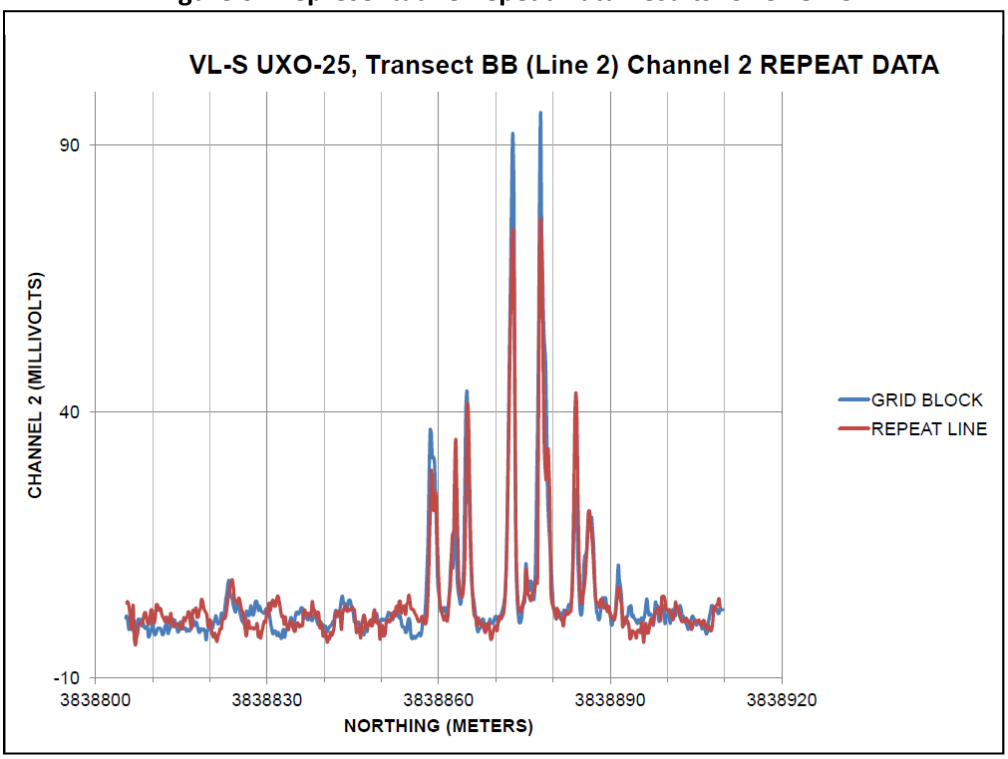
Bottom: **Representative Vibration and Personnel Test Results (Channels 1 through 4)**



The repeat data appear to match well between the production survey and repeat survey. Representative examples of the repeat survey data are presented as **Figure 6.** The results are presented as line graphs depicting the Channel 2 responses from the original survey data and the repeat data. Variations in the peak response from an anomaly identified in the production survey versus the repeat survey line (i.e. peak value of red and blue lines in **Figure 6**) may be attributed to several factors, including, but not limited to the following: variation in the position of the EM61-MK2 coil center with respect to the subsurface target, inadvertent movement of a piece of surface metal as the DGM field crew walked over the object, or a variation in height of EM61-MK2 due to surface

brush. As a result of these factors, the repeat data evaluation is done on a qualitative basis. The repeat data results from the entire survey, along with the Raw Data Delivery and Final Data Delivery Reports, are provided on the CD included with this report.

Figure 6. Representative Repeat Data Results for UXO-25



References

CH2M HILL, 2011. *Geophysical Investigation Plan for Verona Loop Munitions Response Area, Marine Corps Base Camp Lejeune, Jacksonville, North Carolina*. Septmeber.

CH2M HILL, 2012. *MCB Lejeune UXO 26 DGM Final Report*. March.

United States Army Corps of Engineers (USACE), 2001. *Final Range Identification and Preliminary Range Assessment, Marine Corps Base Camp Lejeune, Onslow, North Carolina.* St. Louis District. December.

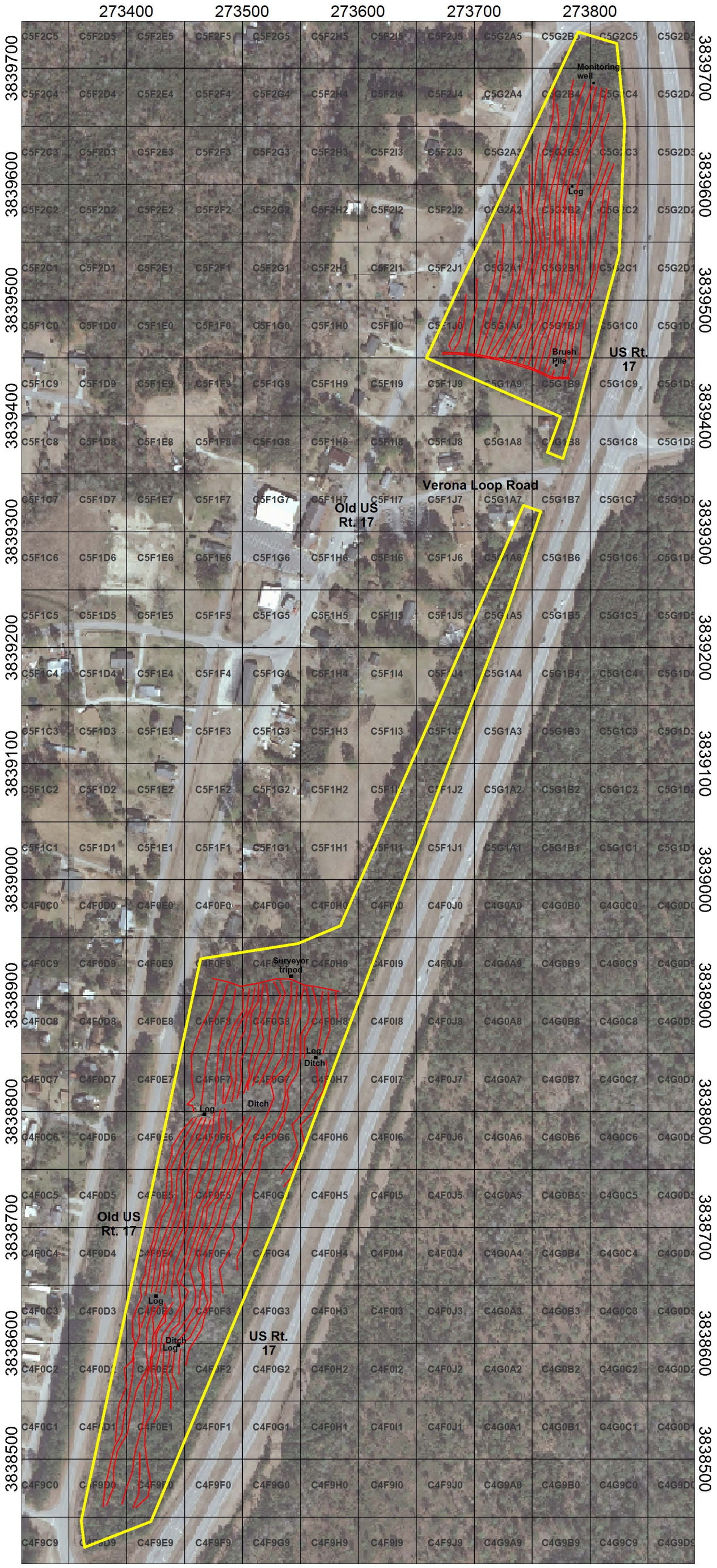


Figure 1
Site Map

Site UXO-25 - Verona Loop
MCIEAST-MCB CAMLEJ
North Carolina

Legend

- Survey Area Boundary
- Transect Path
- C5G2B3 — Site Specific Grid Network
- Cultural Feature

Scale 1:4050

50 0 50 100 150

(meters)

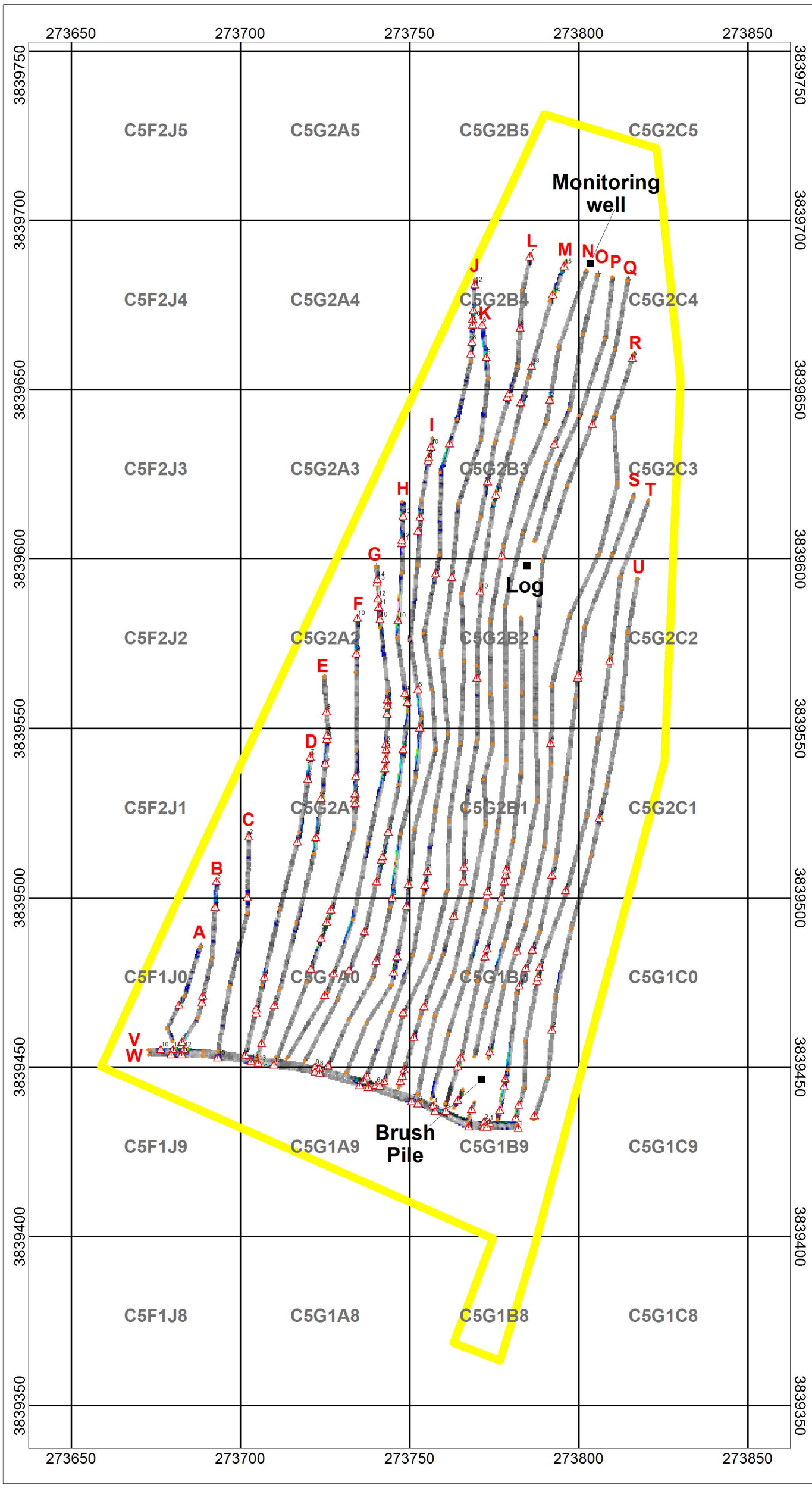
NAD83 / UTM zone 18N

CLIENT:	NAVFAC Mid-Atlantic
PROJECT NUMBER:	424500
CONTRACTOR:	CH2M HILL
Survey Date:	4/24/2012
Created by:	J. Weller
Map Creation Date:	5/30/2012

CH2MHILL®

Figure 2
Verona Loop North

Site UXO-25 - Verona Loop
MCIEAST-MCB CAMLEJ
North Carolina



Legend

- Survey Area Boundary
- Transect Path
- C5G2B3 — Site Specific Grid Network
- Cultural Feature
- Surveyor Stake Point
- Selected Target
- A-W — Transect ID

EM (CH2)
mV
0 2 4 6 8 10 13 16 19 22 25 28 31 34 37 40 43 46 49

Scale 1:1260
25 0 25
(meters)
NAD83 / UTM zone 18N

CLIENT:	NAVFAC Mid-Atlantic
PROJECT NUMBER:	424500
CONTRACTOR:	CH2M HILL
Survey Date:	4/24/2012
Created by:	J. Weller
Map Creation Date:	5/30/2012

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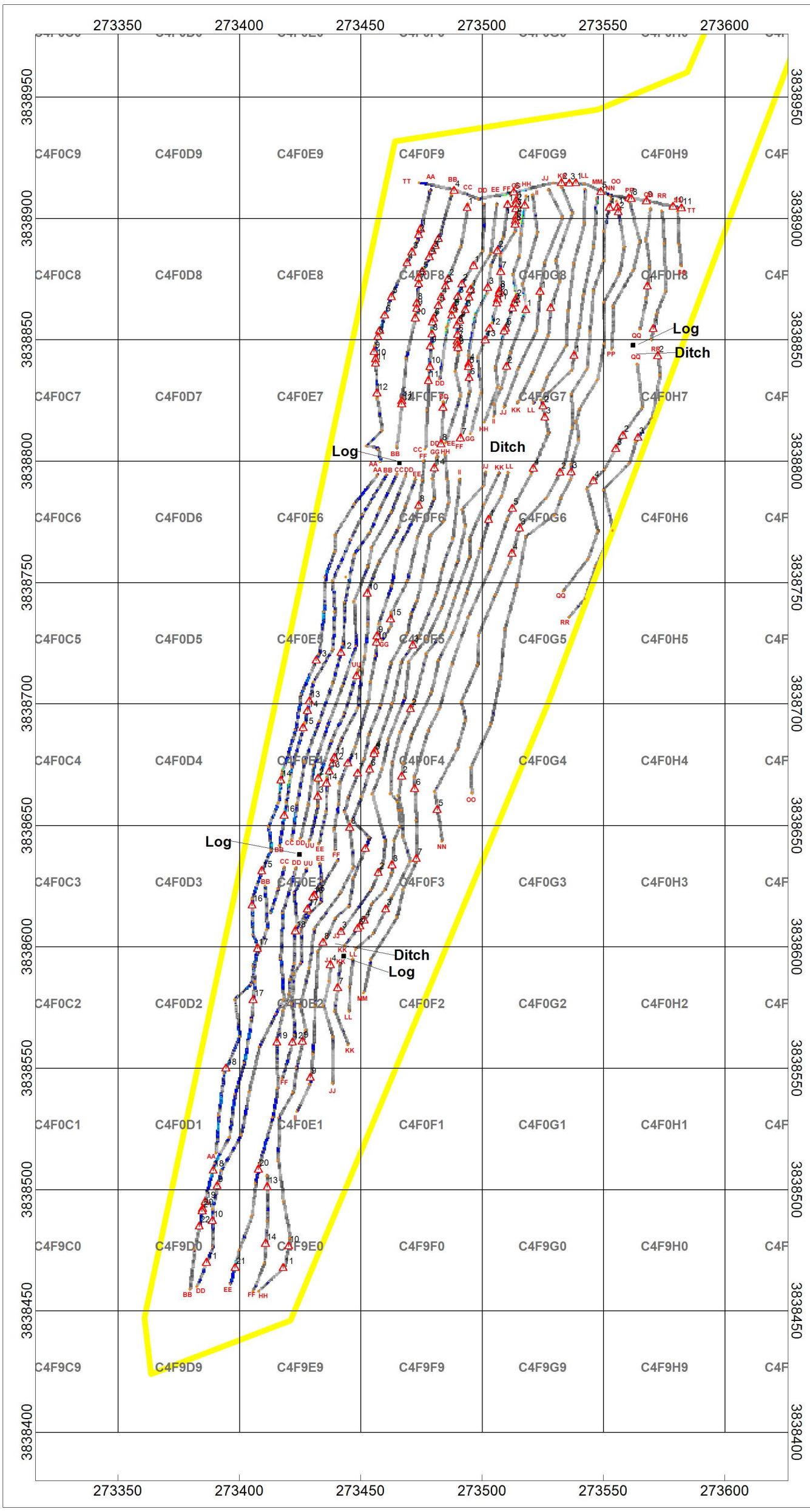
Figure 3
Verona Loop South

Site UXO-25 - Verona Loop
MCIEAST-MCB CAMLEJ
North Carolina



Legend

- Survey Area Boundary
- Transect Path
- C5G2B3 — Site Specific Grid Network
- Cultural Feature
- Surveyor Stake Point
- Selected Target
- AA-UU — Transect ID

EM (CH2)
mV

0 2 4 6 8 10 13 16 19 22 25 28 31 34 37 40 43 46 49

Scale 1:1700

25 0 25 50 75
(meters)

NAD83 / UTM zone 18N

CLIENT:	**NAVFAC Mid-Atlantic**
PROJECT NUMBER:	**424500**
CONTRACTOR:	**CH2M HILL**
Survey Date:	**4/24/2012**
Created by:	**J. Weller**
Map Creation Date:	**5/30/2012**

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Attachment A
Geophysical System Verification Report

This attachment to the *MCIEAST-MCB CAMLEJ UXO-25 DGM Final Report* documents the geophysical system verification (GSV) for the investigation to locate munitions and explosives of concern (MEC) and material potentially presenting an explosive hazard (MPPEH) in the subsurface at site UXO-25, Verona Loop Munitions Response Area (MRA), Marine Corps Base Camp Lejeune (MCIEAST-MCB CAMLEJ) in Jacksonville, North Carolina. CH2M HILL used a two-stage physics-based verification process in which signal strength and sensor performance were demonstrated initially by static and dynamic tests on a test strip and throughout the survey with a blind seeding program. The initial phase involved verification of the person-portable Geonics Ltd. EM61-MK2 digital geophysical mapping (DGM) system using an instrument verification strip (IVS), while the second phase involved the burial of four small industry standard objects (ISOs) within the survey area to demonstrate the continued effectiveness of the system and the survey methodology. The GSV process followed the *Geophysical System Verification Work Plan for Verona Loop Munitions Response Area, Marine Corp Base Camp Lejeune, North Carolina,* Appendix A of the *Geophysical Investigation Plan for Verona Loop Munitions Response Area, Marine Corp Base Camp Lejeune, North Carolina* (CH2M HILL, 2011).

IVS Location

On Monday, April 30, 2012, the CH2M HILL Project Geophysicist and field geophysicist conducted a DGM survey with the EM61-MK2 at the IVS previously established near Site UXO-26, shown on **Figure 1**. Positioning for both the IVS survey and the production DGM survey was accomplished using the fiducial method, where digital marks were inserted into the recorded data files at locations previously recorded by a licensed North Carolina professional land surveyor (PLS), LDSI, Inc[1].

Small ISOs, shown in **Figure 2**, were used as test items in the IVS. The original IVS constructed for UXO-26 contained three buried small ISOs, however, one was removed prior to the UXO-25 IVS survey, leaving two test items for verification of the UXO-25 geophysical system. The locations, depths and orientations of the remaining seed items are shown in **Table 1**. An "as-built" map of the IVS is shown as **Figure 3**.

[1] All coordinates reported in this document and in the IVS data are accurate to the North American Datum of 1983 (NAD83) Universal Transverse Mercator (UTM) Zone 18 North (meters) system.

FIGURE 1
IVS Location

FIGURE 2
Small Industry Standard Object

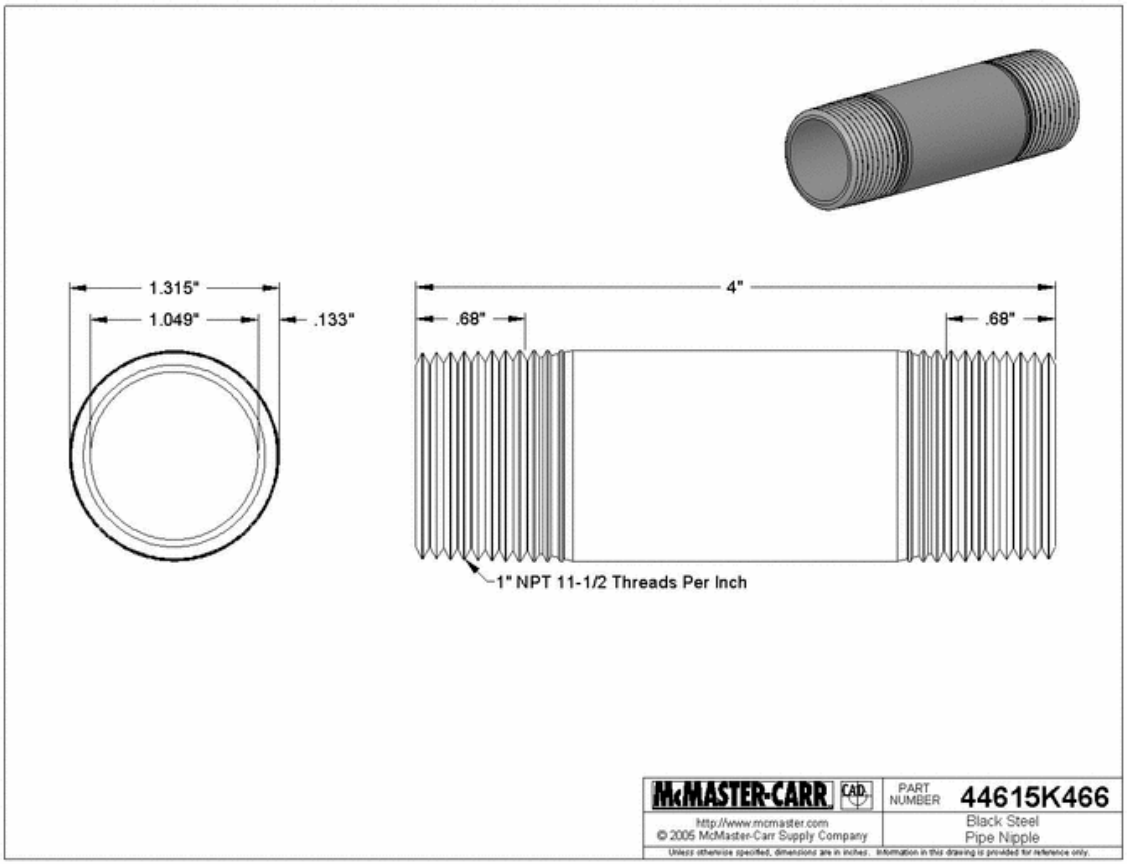


FIGURE 3
IVS As-Built Layout

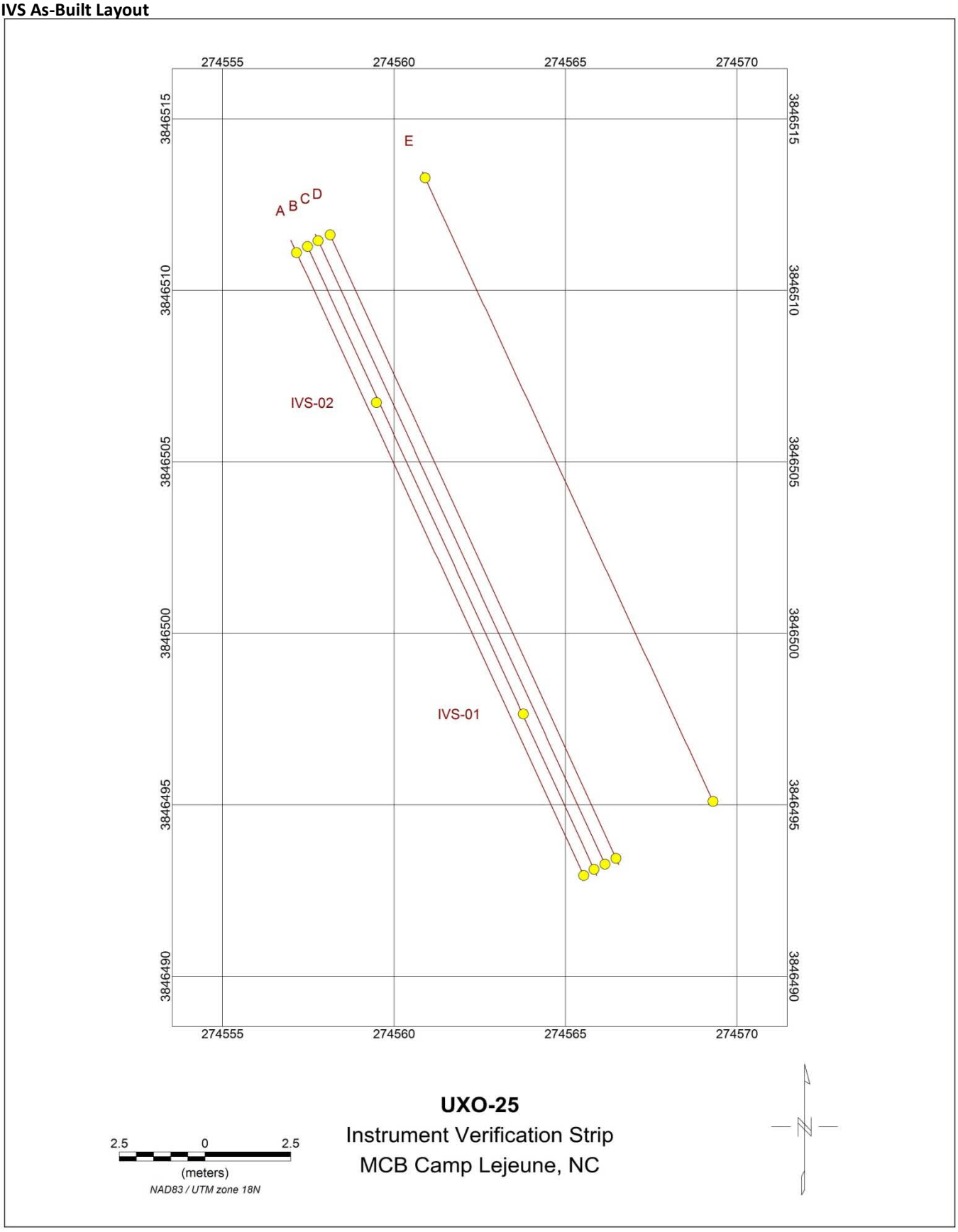


TABLE 1
IVS Survey Coordinates and Locations

Point ID	Easting (m)[1]	Northing (m)[1]	Item Depth[2] (cm)	Item Orientation	Description
IVS-001	274563.77	3846497.65	15	Vertical	Small ISO
IVS-002	274559.49	3846506.73	15	Horizontal, Perpendicular to Direction of Travel	Small ISO

Notes:

[1] All coordinates in North American Datum of 1983 (NAD83), Universal Transverse Mercator (UTM), Zone 18N, Meters.
[2] Measured from ground surface to center of mass of item.

cm = centimeter
ISO = Industry Standard Object

IVS Survey

The EM61-MK2 system was used to collect data along the IVS survey lines shown in **Figure 3**. All data are provided on the data deliverable CD accompanying the *MCIEAST-MCB CAMLEJ UXO-25 DGM Final Report*.

Because of inherent errors associated with depth measurements from a non-uniform ground surface, the IVS survey results are semi-qualitative in nature. As part of the QC testing and measurement quality objectives (MQO) analysis, a small ISO item was also placed on a stand at 46 centimeters above the center of the EM61-MK2 transmit coil and the response recorded to provide a qualitative measure of the system's response to the small ISO.

Results

The results of the IVS survey are shown in **Figure 4**. **Figures 5** and **6** illustrate the amplitude response for each of the IVS seeds plotted against the predicted responses with 20 percent lower and upper bounds. Results of the QC tests (ISO placed horizontally at 46 centimeters above the center of the coil) are also plotted on the figures.

Responses from the IVS seeds vary from the predicted values because of variables that intrinsically inject error into the measurement, including the following:

- Depth measurement: if terrain is not completely flat around excavated holes, an average of the ground level must be determined in the field, resulting in differences of up to several centimeters
- Instrument path: while the instrument operator attempts to maintain a direct path over the seeded items, slight variation to either side can impact the measured response
- Measurement location: because the instrument records are at set measurement intervals, the actual measured response may not be directly over the item when it is at the measurement location used to predict the response curve
- Instrument "bounce": unless terrain is absolutely flat around the seeded item location, the transmit/receive coil can vary in height above the ground surface by several centimeters from the height used to predict the response curve

Because there is limited ability to control the four discussed error variables, the primary measure of the instrument response is the static test with the ISO at a strictly controlled distance from the transmit/receive coil, which matched (within the MQO of 20 percent) the expected response. The survey over the IVS seeds is a secondary measure and can be used to demonstrate kinematic (in motion) detection of the ISOs, demonstrate appropriate falloff of response from deeper items, measure representative background response, and demonstrate positioning system accuracy under kinematic conditions.

FIGURE 4
IVS Survey Results

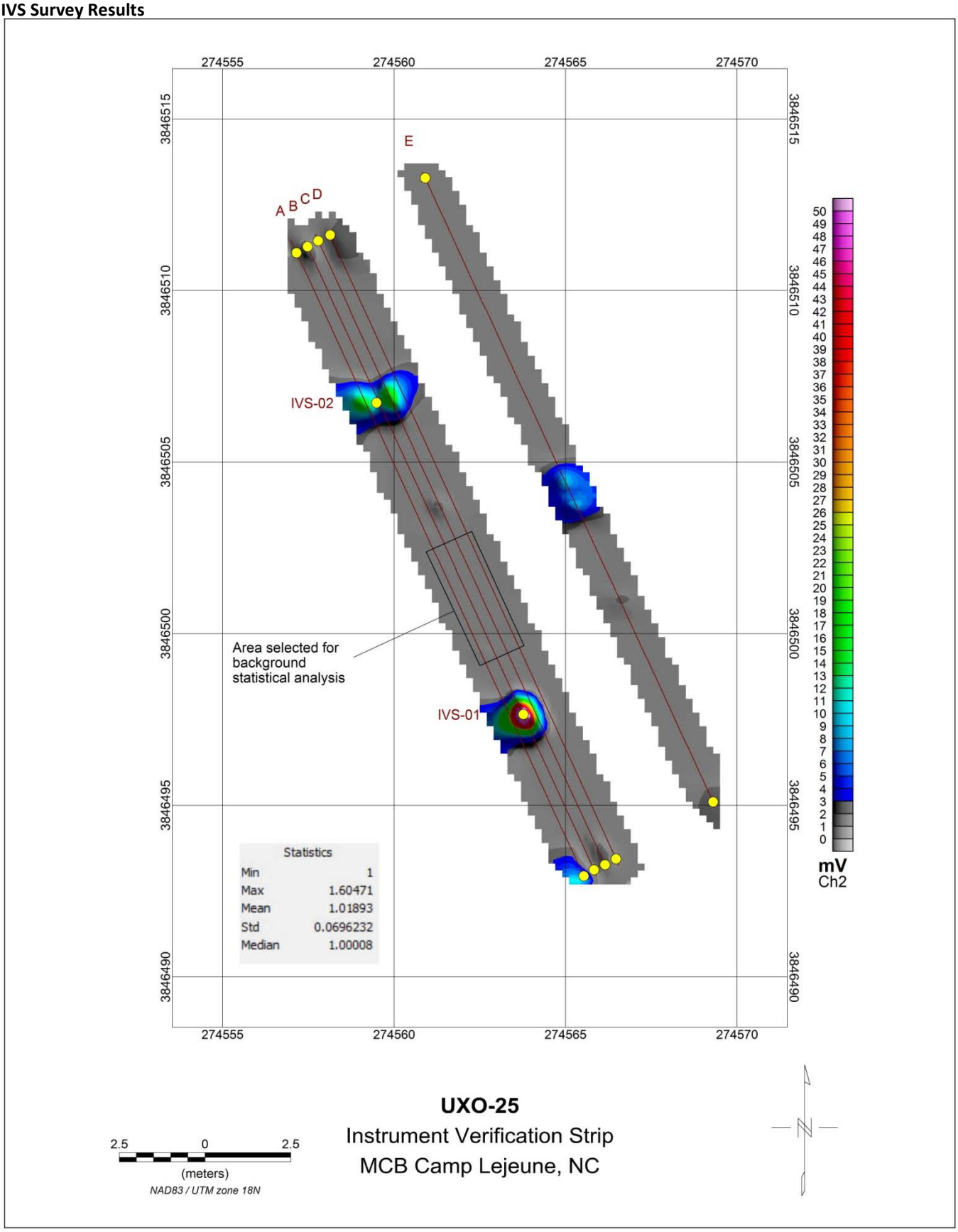
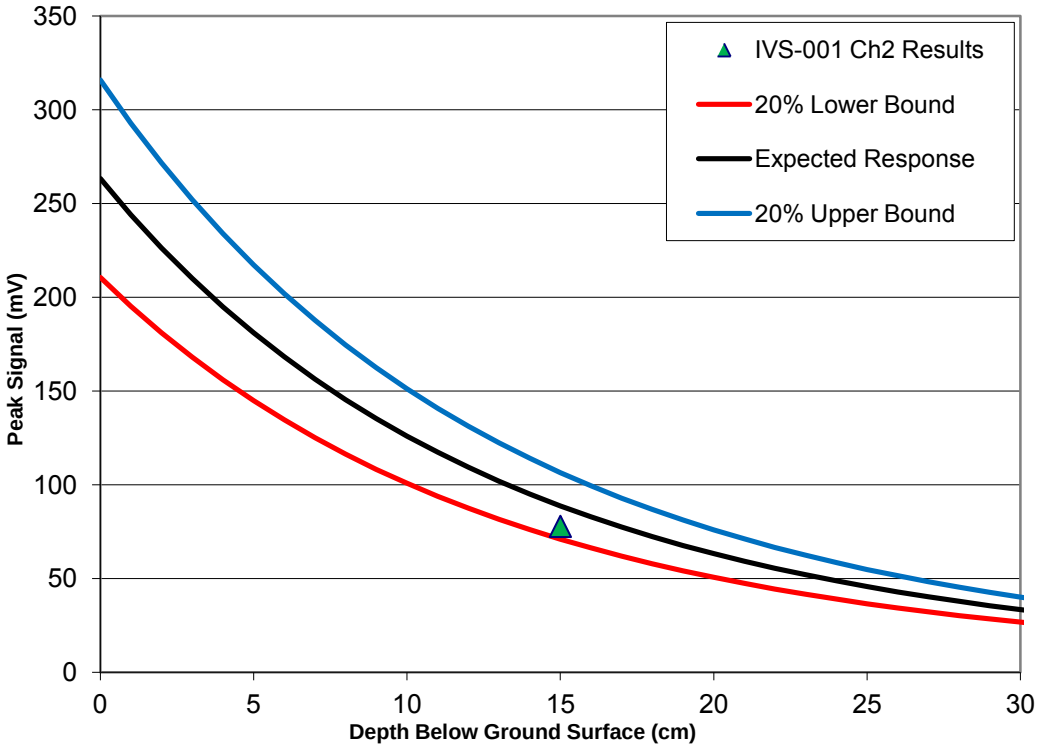
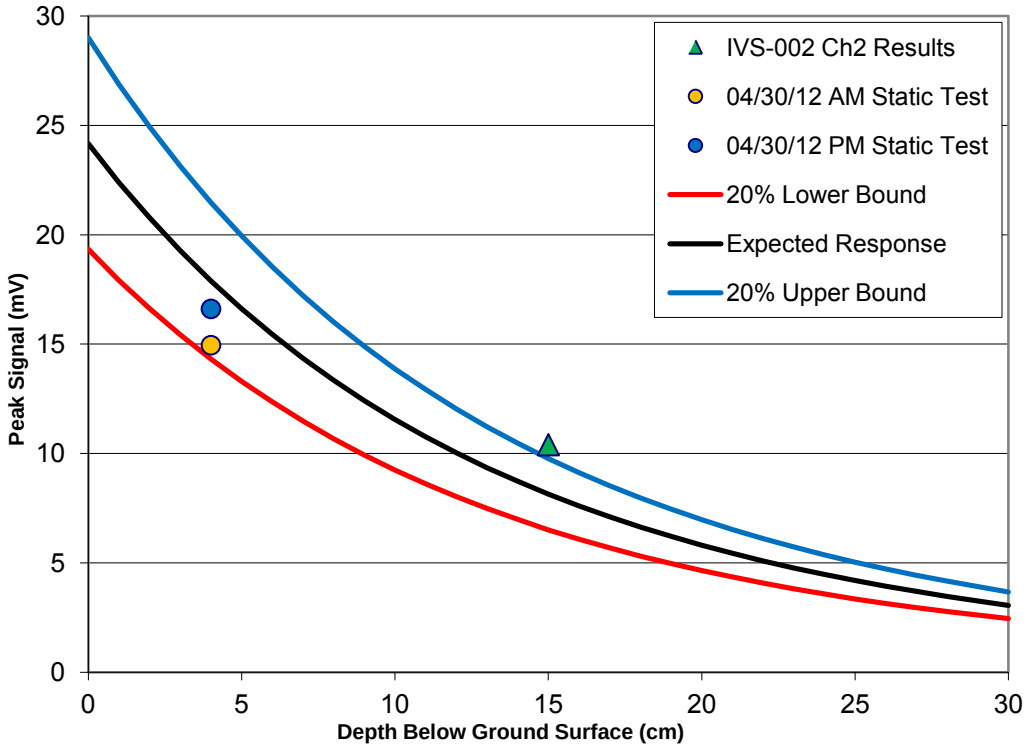


FIGURE 5
IVS Channel 2 Response Compared to the Predicted Small ISO Response – Vertical Item[2]



2 Naval Research Laboratory, NRL/MR/6110--09-9183, *EM61-MK2 Response of Three Munitions Surrogates*, March 12, 2009.

FIGURE 6
IVS Channel 2 Response Compared to the Predicted Small ISO Response – Horizontal Items[3]



Based on the IVS survey, the geophysical background is generally low. A polygon (shown on **Figure 4**) that appears to be representative of the general background data was selected for statistical analysis from the IVS background survey. Statistical results derived in Geosoft Oasis Montaj from the channel 2 data indicate maximum and minimum values of 1.60 millivolts (mV) and 1.00 mV, respectively, with a mean of 1.02 mV and a standard deviation of 0.07 mV. Although it is not possible to suggest that this is representative of the entire site, it is a starting point for determining anomaly selection criteria.

The following approach was adopted for anomaly selection:

1. Baseline threshold of 3 mV on Channel 2 for EM61-MK2 surveys if anomaly has good decay and profile shape[4]
2. Select additional anomalies between 2 and 3 mV if they clearly represent metallic items (very low background noise, good decay and profile shape)
3. Re-evaluate and adjust selection criteria if background noise on any particular transect or area is significantly higher than that observed in the IVS

Information on the types of potential MEC that may be encountered within the UXO-25 DGM investigation area is presented in the *Geophysical Investigation Plan for Verona Loop Munitions Response Area* (CH2M HILL, 2011) and the *Final Range Identification and Preliminary Range Assessment, Marine Corps Base Camp Lejeune, Onslow, North Carolina* (United States Army Corps of Engineers, 2001a). Live Fire and Maneuver Exercises were reportedly conducted within the vicinity of the investigation area, and the use of mortars, recoilless rifles, 2.36-inch rockets and hand and rifle grenades is possible within this area. Specifically, the following munitions are listed in the

[3] Naval Research Laboratory, NRL/MR/6110--09-9183, *EM61-MK2 Response of Three Munitions Surrogates*, March 12, 2009.

[4] While there are no absolute measures for good decay and profile shape, and the experience of the data processor is important in determining this, the general measures are that the amplitude of each subsequent channel (Channels 1 through 4) is less than the previous channel and the shape falls off in a parabolic shape to either side of the anomaly.

aforementioned documents: Hand Grenades (all types), Rifle Grenades (all types), 60mm Mortar, 81mm Mortar, 37mm Gun, 40mm Gun, 75mm Howitzer, 105mm Howitzer, 155mm Howitzer and Gun, 57mm Recoilless Rifle, 75mm Recoilless Rifle, 90mm Recoilless Rifle, 2.36-inch Rocket (HEAT and Practice). Blank small arms ammunition and pyrotechnics were also reportedly used.

The anomaly selection criteria established for the UXO-25 DGM would be adequate for identifying geophysical anomalies that may be indicative of the types of potential MEC to be encountered within the investigation area. This threshold may also identify potential small arms ammunition, but the ability to do so would also factor potential quantities and depth of small arms ammunition as well as localized noise conditions that may impact the DGM data.

Quality Control and Measurement Quality Objectives

All QC tests were performed as specified in the project work plan, with no discrepancies noted. All data are provided on the data deliverable CD accompanying the *MCIEAST-MCB CAMLEJ UXO-25 DGM Final Report*. The MQOs, measurement performance criteria, and test methods established for the IVS are summarized in **Table 2**.

TABLE 2
IVS Measurement Quality Objectives

Data Quality Objective	Measurement Performance Criteria	Test Method During IVS
General System Verification		
DGM System Positioning. Accurate coordinates are being obtained during DGM survey.	Positional error of ISO seeds will not exceed 25 centimeters (9.8 inches).	Results of IVS DGM survey vs. IVS seed locations were evaluated to ensure compliance.
DGM System Munitions Detection. DGM system response is within industry standards for detection.	Response to ISO is comparable to published or calculated results for that item. Response to standardized item will not vary more than ±20%of expected value in static test.	Results of IVS surveys over seed items in strip were qualitatively reviewed. Results of static test were quantitatively reviewed to ensure compliance.
Data Handling		
All data must be delivered in a timely manner and in a useable format.	IVS data is completed and delivered within 12 hrs.	Evaluated based on actual delivery of data

[1] NRL/MR/6110--09-9183 (Shown on Figures 5 and 6)

Blind Seeding Program

Four ISOs were buried within the UXO-25 survey area as on-going verification of the geophysical system and methodology. Two QC seed items were buried in the northern section of the site, and two were buried in the southern section of the site. The locations of the QC seed items were recorded by the project land surveying subcontractor, ECLS. The locations were known only to CH2M HILL Quality Control personnel. All four seed items were identified within 25 cm of their surveyed locations and selected as target anomalies during the DGM survey.

Conclusions

CH2M HILL performed an IVS survey to verify DGM equipment before use of the system for surveys within Site UXO-25 at MCIEAST-MCB CAMLEJ. The system was verified as functioning within industry standards and meeting project MQOs. A recommended approach for anomaly selection has been provided for discussion and agreement with the project team. All blind QC seed items emplaced in the UXO-25 survey area were identified during the DGM survey and selected as target anomalies.

References

CH2M HILL, 2011. *Geophysical Investigation Plan for Verona Loop Munitions Response Area.* September.

United States Army Corps of Engineers (USACE), 2001a. *Final Range Identification and Preliminary Range Assessment, Marine Corps Base Camp Lejeune, Onslow, North Carolina.* St. Louis District. December.

Appendix E
Raw Analytical Data

TABLE E-1

Surface Soil Raw Analytical Data

Site UXO-25 - Verona Loop PA/SI

MCIEAST-MCB CAMLEJ

North Carolina

Station ID	VL-MW01	VL-IS02	VL-IS03		VL-IS04	VL-IS05	VL-IS06	VL-IS07	VL-IS08	VL-IS09	VL-IS10	VL-IS11	VL-IS12	VL-IS13	VL-IS14		VL-MW02	VL-IS16
Sample ID	VL-SS01-12B	VL-SS02-12B	VL-SS03-12B	VL-SS03D-12B	VL-SS04-12B	VL-SS05-12B	VL-SS06-12B	VL-SS07-12B	VL-SS08-12B	VL-SS09-12B	VL-SS10-12B	VL-SS11-12B	VL-SS12-12B	VL-SS13-12B	VL-SS14-12B	VL-SS14D-12B	VL-SS15-12B	VL-SS16-12B
Sample Date	04/25/12	04/25/12	04/25/12	04/25/12	04/25/12	04/25/12	04/25/12	04/25/12	04/25/12	04/26/12	04/25/12	04/26/12	04/26/12	04/26/12	04/26/12	04/26/12	04/25/12	04/26/12
Chemical Name																		
Explosives (µg/kg)																		
1,3,5-Trinitrobenzene	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U
1,3-Dinitrobenzene	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U
2,4,6-Trinitrotoluene	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U
2,4-Dinitrotoluene	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U
2,6-Dinitrotoluene	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U
2-Amino-4,6-dinitrotoluene	400 U	400 U	400 U	400 U	400 U	400 U	400 U	400 U	400 U	400 U	400 U	400 U	400 U	400 U	400 U	400 U	400 U	400 U
2-Nitrotoluene	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U
3-Nitrotoluene	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U
4-Amino-2,6-dinitrotoluene	400 U	400 U	400 U	400 U	400 U	400 U	400 U	400 U	400 U	400 U	400 U	400 U	400 U	400 U	400 U	400 U	400 U	400 U
4-Nitrotoluene	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U
HMX	400 U	400 U	400 U	400 U	400 U	400 U	400 U	400 U	400 U	400 U	400 U	400 U	400 U	400 U	400 U	400 U	400 U	400 U
Nitrobenzene	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U
Nitroglycerin	2,500 U	2,500 U	2,500 U	2,500 U	2,500 U	2,500 U	2,500 U	2,500 U	2,500 U	2,500 U	2,500 U	2,500 U	2,500 U	2,500 U	2,500 U	2,500 U	2,500 U	2,500 U
Perchlorate	1.1 U	1.3 U	1.5 U	1.4 U	1.2 U	0.84 J	1.3 U	1.2 U	1.6 U	1.3 U	1.2 U	1.3 U	1.4 U	1.2 U	1.5 U	1.5 U	1.2 U	1.5 U
PETN	1,000 U	1,000 U	1,000 U	1,000 U	1,000 U	1,000 U	1,000 U	1,000 U	1,000 U	1,000 U	1,000 U	1,000 U	1,000 U	1,000 U	1,000 U	1,000 U	1,000 U	1,000 U
RDX	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U
Tetryl	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U
Total Metals (mg/kg)																		
Aluminum	750	3,300	6,900	7,300	4,900	2,500	6,300	3,600	15,000	7,600	1,100	6,400	16,000	7,500	18,000	15,000	1,500	9,700
Antimony	0.053 J	0.081 J	0.32	0.092 J	0.053 J	0.11 J	0.044 J	0.025 J	0.33	0.059 J	0.05 U	0.05 U	0.052 J	0.047 J	0.13 J	0.11 J	0.054 J	0.054 J
Arsenic	0.28 J	0.68	1	1.1	0.63	0.49 J	0.69	0.57	6.9	1.2	0.34 J	0.75	2.2	1.6	2.1	1.9	0.47 J	0.93
Barium	2.4	7.5	16	15	5.2	5.4	12	7.2	36	15	4.2	8.8	20	5.6	31	27	6	12
Beryllium	0.05 U	0.053 J	0.055 J	0.13	0.025 J	0.03 J	0.058 J	0.034 J	0.37	0.13	0.046 U	0.11	0.3	0.033 J	0.3	0.32	0.025 J	0.12
Cadmium	0.016 J	0.01 J	0.03 J	0.058	0.0079 J	0.041 J	0.02 J	0.01 J	0.15	0.033 J	0.013 J	0.0043 J	0.018 J	0.0059 J	0.058	0.055	0.0097 J	0.016 J
Calcium	97	72	450	430	68	120	220	76	4,200	720	89	50 U	110	50 U	720	570	190	110
Chromium (hexavalent)	0.22 UJ	1.92 J-	0.29 UJ	0.26 UJ	0.31 J-	0.23 UJ	0.27 UJ	0.29 J-	0.3 UJ	0.25 UJ	0.23 UJ	0.5 J-	0.41 J-	0.58 J-	0.26 J-	0.28 J-	0.24 UJ	0.97 J-
Chromium	0.81 J	3.8 J	5 J	6.3 J	3.9 J	2.2 J	5.2 J	2.8 J	16 J	5.6 J	0.96 J	5.5 J	12 J	6.5 J	12 J	12 J	1.9 J	6.4 J
Cobalt	0.032 J	0.21	0.21 J	0.29 J	0.13	0.073 J	0.2	0.13	1.6	0.32	0.046 J	0.17	0.56	0.36	0.73	0.62	0.056 J	0.28
Copper	0.38	0.63	1.1	1.4	0.33	2.6	1	0.51	6.7	1.2	0.41	0.31	0.77	1.8	2.4	1.9	0.34	0.46
Iron	570	1,000	3,600	3,600	3,200	1,500	2,500	2,000	9,000	3,000	880	1,600	4,300	3,600	4,700	3,700	740	2,200
Lead	4.7	9.8	38	12	6.3	5.8	7.1	5.6	42	10	2.8	6.5	12	9	56	46	7	11
Magnesium	32 J	60	140	130	110	49 J	130	75	420	180	32 J	140	370	170	380	310	59	240
Manganese	3	1.9	5.8 J	14 J	3.9	2.3	4	6.2	79	4.3	3.3	2.9	4.7	3.3	4.7	4.3	2.6	3.7
Mercury	0.009 J	0.024 J	0.027 J	0.057	0.021 J	0.018 J	0.021 J	0.019 J	0.054	0.032 J	0.014 J	0.017 J	0.055	0.016 J	0.075	0.063	0.014 J	0.031 J
Nickel	1.3 J	3.5 J	5.9 J	8.3 J	3.1 J	3.1 J	3.9 J	3 J	4.6 J	2.6 J	2.4 J	0.74 J	2.8 J	1.9 J	3.6 J	4.9 J	0.85 J	4.3 J
Potassium	41 J	91	140	130	88	41 J	130	83	470	210	58	180	440	170	420	350	68	310
Selenium	0.11 J	0.37 J	0.52	0.55	0.21 J	0.24 J	0.4 J	0.15 J	1.2	0.53	0.14 J	0.34 J	1.2	0.24 J	0.75	0.74	0.23 J	0.47 J
Silver	0.01 U	0.0044 J	0.006 J	0.0078 J	0.01 U	0.01 U	0.007 J	0.01 U	0.021 J	0.0087 J	0.0093 U	0.01 U	0.0088 J	0.0046 J	0.017 J	0.018 J	0.01 U	0.007 J
Sodium	25 U	23 U	25 U	25 U	23 U	25 U	25 U	25 U	95	22 J	25 U	8.3 J	22 J	6.7 J	34 J	28 J	25 U	21 J
Thallium	0.01 J	0.021 J	0.05 J	0.087 J	0.029 J	0.033 J	0.043 J	0.037 J	0.13	0.053 J	0.015 J	0.043 J	0.13	0.046 J	0.11	0.1	0.011 J	0.063 J
Vanadium	2.5 J	4.2 J	7.4 J	9.1 J	7.3 J	3.1 J	7 J	5.3 J	29 J	9.7 J	2.8 J	8 J	19 J	12 J	16 J	14 J	2.7 J	8.3 J
Zinc	2.1	2.4	5.1 J	10 J	2.5	2.6	3.4	2.3	120	7.4	1.6 J	1.3 J	6.3	5.4	11	9.2	1.4 J	4.5

Notes:

Shading indicates detections

J - Analyte present, value may or may not be accurate or precise

J- - Analyte present, value may be biased low, actual value may be higher

U - The material was analyzed for, but not detected

UJ - Analyte not detected, quantitation limit may be inaccurate

mg/kg - Milligrams per kilogram

µg/kg - Micrograms per kilogram

TABLE E-2

Subsurface Soil Raw Analytical Data

Site UXO-25 - Verona Loop PA/SI

MCIEAST-MCB CAMLEJ

North Carolina

Station ID	VL-MW01	VL-IS02	VL-IS03		VL-IS04	VL-IS05	VL-IS06	VL-IS07	VL-IS08	VL-IS09	VL-IS10	VL-IS11	VL-IS12	VL-IS13
Sample ID	VL-SB01-1-6-12B	VL-SB02-1-5-12B	VL-SB03-1-5-12B	VL-SB03D-1-5-12B	VL-SB04-1-5-12B	VL-SB05-1-5-12B	VL-SB06-1-5-12B	VL-SB07-1-4-12B	VL-SB08-1-4-12B	VL-SB09-1-4-12B	VL-SB10-1-4-12B	VL-SB11-1-4-12B	VL-SB12-1-4-12B	VL-SB13-1-4-12B
Sample Date	04/24/12	04/25/12	04/25/12	04/25/12	04/25/12	04/25/12	04/25/12	04/25/12	04/25/12	04/26/12	04/25/12	04/26/12	04/26/12	04/26/12
Chemical Name														
Explosives (µg/kg)														
1,3,5-Trinitrobenzene	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U
1,3-Dinitrobenzene	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U
2,4,6-Trinitrotoluene	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U
2,4-Dinitrotoluene	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U
2,6-Dinitrotoluene	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U
2-Amino-4,6-dinitrotoluene	400 U	400 U	400 U	400 U	400 U	400 U	400 U	400 U	400 U	400 U	400 U	400 U	400 U	400 U
2-Nitrotoluene	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U
3-Nitrotoluene	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U
4-Amino-2,6-dinitrotoluene	400 U	400 U	400 U	400 U	400 U	400 U	400 U	400 U	400 U	400 U	400 U	400 U	400 U	400 U
4-Nitrotoluene	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U
HMX	400 U	400 U	400 U	400 U	400 U	400 U	400 U	400 U	400 U	400 U	400 U	400 U	400 U	400 U
Nitrobenzene	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U
Nitroglycerin	2,500 U	2,500 U	2,500 U	2,500 U	2,500 U	2,500 U	2,500 U	2,500 U	2,500 U	2,300 U	2,500 U	2,500 U	2,500 U	2,500 U
Perchlorate	1.2 U	1.3 U	1.2 U	1.2 U	1.2 U	1.2 U	1.2 U	1.2 U	1.4 U	1.3 U	1.2 U	1.5 U	1.4 U	1.3 U
PETN	1,000 U	1,000 U	1,000 U	1,000 U	1,000 U	1,000 U	1,000 U	1,000 U	1,000 U	910 U	1,000 U	1,000 U	1,000 U	1,000 U
RDX	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U
Tetryl	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U
Total Metals (mg/kg)														
Aluminum	4,100	10,000	13,000	14,000	7,100	8,000	10,000	11,000	13,000	8,000	13,000	13,000	18,000	8,500
Antimony	0.05 U	0.046 U	0.054 J	0.05 J	0.055 J	0.069 J	0.033 J	0.033 J	0.17 J	0.05 U	0.068 J	0.054 J	0.032 J	0.033 J
Arsenic	0.57	0.62	1.3	1.4	1.2	1.3	0.72	1.6	3	1.1	2.3	1.4	2.9	1.5
Barium	2.1 J	10 J	14 J	15 J	6.1 J	4.8 J	13 J	26 J	23 J	9.3 J	7.5 J	12 J	20 J	6.8 J
Beryllium	0.022 J	0.083 J	0.089 J	0.071 J	0.032 J	0.023 J	0.071 J	0.14	0.22	0.082 J	0.046 J	0.1	0.22	0.036 J
Cadmium	0.046 U	0.02 J	0.0052 J	0.05 U	0.0041 J	0.0096 J	0.05 U	0.0039 J	0.069	0.0086 J	0.05 U	0.0057 J	0.0074 J	0.05 U
Calcium	50 U	50 U	50 U	50 U	50 U	46 U	50 U	64	3,000	190	50 U	50 U	110	21 J
Chromium (hexavalent)	3.71 J-	3.25 J-	4.27 J-	4.45 J-	4.77 J-	5.97 J-	4.28 J-	3.8 J-	0.27 UJ	1.36 J-	5.05 J-	6.59 J-	2.43 J-	3.78 J-
Chromium	4.6	7.5	9.5	10	6.6	8.6	9.4	10	10	5.9	10	9.5	11	7.7
Cobalt	0.26	0.32	0.5	0.54	0.24	0.25	0.43	0.49	0.73	0.25	0.46	0.37	0.53	0.36
Copper	0.52	0.16 J	0.48	0.55	0.41	0.57	0.34	1.3	3.3	0.6	1.2	0.26	0.44	1.2
Iron	1,700	1,200	4,400	4,100	4,300	4,900	4,100	6,900	7,500	3,300	9,300	10,000	4,400	2,700
Lead	2.4	5.2	5.8	6.2	4	3.1	5	5.9	18	5.9	4.4	4.9	7.9	5.1
Magnesium	68	240	360	360	170	110	300	340	340	170	270	320	450	200
Manganese	1.7	2.9	5	4.9	3.1	2.6	5	6.9	31	3.2	3.8	3.7	4.5	3.4
Mercury	0.017 U	0.017 J	0.008 J	0.012 J	0.0098 J	0.014 J	0.011 J	0.017 J	0.033 J	0.02 J	0.013 J	0.014 J	0.036 J	0.016 J
Nickel	1.2	1.3	2.1	2.2	1	1.2	1.7	2	2.7	1.3	2	1.5	2.9	1.7
Potassium	79	230	250	260	170	110	220	260	410	200	270	330	540	230
Selenium	0.12 J	0.28 J	0.21 J	0.31 J	0.31 J	0.29 J	0.18 J	0.27 J	0.74	0.34 J	0.39 J	0.29 J	0.55	0.2 J
Silver	0.0092 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.0094 U	0.011 J	0.0047 J	0.01 U	0.0047 J	0.0047 J	0.01 U
Sodium	25 U	25 U	25 U	25 U	25 U	23 U	25 U	23 U	93	19 J	25 U	17 J	25 J	6.6 J
Thallium	0.015 J	0.095 J	0.1	0.11	0.045 J	0.045 J	0.091 J	0.1	0.091 J	0.052 J	0.065 J	0.083 J	0.12	0.058 J
Vanadium	4.9	7.6	14	15	10	11	11	17	18	11	19	19	25	15
Zinc	1.6 J	3	4.7	5.8	2.5	5	3.9	4.3	44	4	2.8	2.3	5.4	6.4

Notes:

Shading indicates detections

J - Analyte present, value may or may not be accurate or precise

J- - Analyte present, value may be biased low, actual value may be higher

U - The material was analyzed for, but not detected

UJ - Analyte not detected, quantitation limit may be inaccurate

mg/kg - Milligrams per kilogram

µg/kg - Micrograms per kilogram

TABLE E-2

Subsurface Soil Raw Analytical Data

Site UXO-25 - Verona Loop PA/SI

MCIEAST-MCB CAMLEJ

North Carolina

Station ID	VL-IS14		VL-MW02	VL-IS16
Sample ID	VL-SB14-1-4-12B	VL-SB14D-1-4-12B	VL-SB15-1-6_5-12B	VL-SB16-1-5-12B
Sample Date	04/26/12	04/26/12	04/24/12	04/26/12
Chemical Name				
Explosives (µg/kg)				
1,3,5-Trinitrobenzene	200 U	200 U	200 U	200 U
1,3-Dinitrobenzene	200 U	200 U	200 U	200 U
2,4,6-Trinitrotoluene	200 U	200 U	200 U	200 U
2,4-Dinitrotoluene	200 U	200 U	200 U	200 U
2,6-Dinitrotoluene	200 U	200 U	200 U	200 U
2-Amino-4,6-dinitrotoluene	400 U	400 U	400 U	400 U
2-Nitrotoluene	200 U	200 U	200 U	200 U
3-Nitrotoluene	200 U	200 U	200 U	200 U
4-Amino-2,6-dinitrotoluene	400 U	400 U	400 U	400 U
4-Nitrotoluene	200 U	200 U	200 U	200 U
HMX	400 U	400 U	400 U	400 U
Nitrobenzene	200 U	200 U	200 U	200 U
Nitroglycerin	2,500 U	2,500 U	2,500 U	2,500 U
Perchlorate	1.5 U	1.4 U	1.2 U	1.3 U
PETN	1,000 U	1,000 U	1,000 U	1,000 U
RDX	200 U	200 U	200 U	200 U
Tetryl	200 U	200 U	200 U	200 U
Total Metals (mg/kg)				
Aluminum	15,000 J	11,000 J	5,200	11,000
Antimony	0.05 U	0.05 U	0.047 U	0.029 J
Arsenic	0.98 J	1.4 J	0.45 J	1.2
Barium	18 J	15 J	9.5 J	12 J
Beryllium	0.11	0.14	0.13	0.1
Cadmium	0.0051 J	0.0056 J	0.01 J	0.0061 J
Calcium	140	130	72	31 J
Chromium (hexavalent)	3.31 J-	3.3 J-	3.9 J-	4.55 J-
Chromium	9.3	9.3	5.3	8.6
Cobalt	0.38	0.31	0.14	0.3
Copper	0.27	0.24	0.48	0.22
Iron	2,400	2,000	1,000	3,600
Lead	6.7	6.8	4.1	5.8
Magnesium	410 J	270 J	150	280
Manganese	4.2	3.4	3.8	3.9
Mercury	0.024 J	0.025 J	0.017 U	0.017 J
Nickel	1.6	1.3	0.57	1.1
Potassium	410	320	300	320
Selenium	0.34 J	0.51	0.16 J	0.38 J
Silver	0.0083 J	0.0077 J	0.0058 J	0.0053 J
Sodium	22 J	18 J	25 U	18 J
Thallium	0.12	0.11	0.051 J	0.085 J
Vanadium	11	9	7.5	12
Zinc	4.9 J	3.3 J	2.1	3.2

Notes:

Shading indicates detections

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J- - Analyte present, value may be biased low, actual value may be higher

U - The material was analyzed for, but not detected

UJ - Analyte not detected, quantitation limit may be inaccurate

mg/kg - Milligrams per kilogram

µg/kg - Micrograms per kilogram

TABLE E-3

Groundwater Raw Analytical Data

Site UXO-25 - Verona Loop PA/SI

MCIEAST-MCB CAMLEJ

North Carolina

Station ID	VL-MW01	VL-MW02	
Sample ID	VL-GW01-12B	VL-GW02-12B	VL-GW02D-12B
Sample Date	04/26/12	04/26/12	04/26/12
Chemical Name			
Explosives (µg/l)			
1,3,5-Trinitrobenzene	0.52 U	0.52 U	0.52 U
1,3-Dinitrobenzene	0.52 U	0.52 U	0.52 U
2,4,6-Trinitrotoluene	0.52 U	0.52 U	0.52 U
2,4-Dinitrotoluene	0.52 U	0.52 U	0.52 U
2,6-Dinitrotoluene	0.52 U	0.52 U	0.52 U
2-Amino-4,6-dinitrotoluene	1 U	1 U	1 U
2-Nitrotoluene	0.52 U	0.52 U	0.52 U
3-Nitrotoluene	0.52 U	0.52 U	0.52 U
4-Amino-2,6-dinitrotoluene	0.52 U	0.52 U	0.52 U
4-Nitrotoluene	0.52 U	0.52 U	0.52 U
HMX	0.52 UJ	0.52 UJ	0.52 UJ
Nitrobenzene	0.52 U	0.52 U	0.52 U
Nitroglycerin	0.65 U	0.65 U	0.65 U
Perchlorate	0.1 U	0.1 U	0.1 U
PETN	0.65 U	0.65 U	0.65 U
RDX	0.52 U	0.52 U	0.52 U
Tetryl	0.52 U	0.52 U	0.52 U
Total Metals (µg/l)			
Aluminum	130	150	89 J
Antimony	0.5 U	0.5 U	0.5 U
Arsenic	0.26 J	0.5 U	0.5 U
Barium	19	43	40
Beryllium	0.4 U	0.12 J	0.4 U
Cadmium	0.051 J	0.1 U	0.1 U
Calcium	3,400	2,300	2,100
Chromium (hexavalent)	10 U	10 U	10 U
Chromium	0.22 J	0.47 J	0.24 J
Cobalt	0.56 J	1.3	1.2
Copper	0.25 J	0.38 J	0.25 J
Iron	680	1,100	980
Lead	0.19 J	0.16 J	0.17 J
Magnesium	780	610	570
Manganese	18	42	39
Mercury	0.1 U	0.46	0.1 U
Nickel	0.99 J	2.6	2.3
Potassium	500	1,300	1,300
Selenium	1 U	1 U	0.63 J
Silver	0.1 U	0.1 U	0.1 U
Sodium	5,000	9,300	8,800
Thallium	0.1 U	0.1 U	0.1 U
Vanadium	0.4 J	0.33 J	0.29 J
Zinc	10	20 J	35 J

TABLE E-3

Groundwater Raw Analytical Data

Site UXO-25 - Verona Loop PA/SI

MCIEAST-MCB CAMLEJ

North Carolina

Station ID	VL-MW01	VL-MW02	
Sample ID	VL-GW01-12B	VL-GW02-12B	VL-GW02D-12B
Sample Date	04/26/12	04/26/12	04/26/12
Chemical Name			
Dissolved Metals (µg/l)			
Aluminum, Dissolved	31 J	50 U	50 U
Antimony, Dissolved	0.5 U	0.5 U	0.5 U
Arsenic, Dissolved	0.5 U	0.25 J	0.5 U
Barium, Dissolved	20	36	32
Beryllium, Dissolved	0.4 U	0.4 U	0.12 J
Cadmium, Dissolved	0.1 U	0.1 U	0.1 U
Calcium, Dissolved	3,500	2,000	2,000
Chromium, Dissolved	0.21 J	0.5 U	0.5 U
Cobalt, Dissolved	0.6 J	0.98 J	1
Copper, Dissolved	0.5 U	0.34 J	0.79 J
Iron, Dissolved	630	1,100	1,100
Lead, Dissolved	0.5 U	0.5 U	0.5 U
Magnesium, Dissolved	810	560	590
Manganese, Dissolved	20	32	33
Mercury, Dissolved	0.1 U	0.19 J	0.1 U
Nickel, Dissolved	0.96 J	2	2.1
Potassium, Dissolved	530	1,200	1,300
Selenium, Dissolved	1.3 J	1 U	1.4 J
Silver, Dissolved	0.1 U	0.1 U	0.1 U
Sodium, Dissolved	5,100	8,800	9,100
Thallium, Dissolved	0.1 U	0.1 U	0.1 U
Vanadium, Dissolved	0.38 J	0.15 J	0.14 J
Zinc, Dissolved	12 J	22 J	14 J

Notes:

Shading indicates detections

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U - The material was analyzed for, but not detected

UJ - Analyte not detected, quantitation limit may be inaccurate

µg/l - Micrograms per liter

Appendix F
Human Health Risk Screening Results

TABLE B-1

Occurrence, Distribution, and Selection of Chemicals of Potential Concern

Site UXO-25 - Verona Loop PA/SI

MCIEAST -MCB CAMLEJ, North Carolina

Scenario Timeframe: Current/Future
Medium: Surface Soil
Exposure Medium: Surface Soil

Exposure Point	CAS Number	Chemical	Minimum [1] Concentration Qualifier	Maximum [1] Concentration Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration [2] Used for Screening	Background [3] Value	Screening [4] Toxicity Value	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for [5] Contaminant Deletion or Selection
Surface Soil	121-14-2	2,4-Dinitrotoluene	ND	ND	MG/KG		0/16	2.5 - 2.5	2.5E+00	N/A	1.6E+00 C	1.6E-03	NCSSL	YES	DLASL
	606-20-2	2,6-Dinitrotoluene	ND	ND	MG/KG		0/16	2.5 - 2.5	2.5E+00	N/A	6.1E+00 N	N/A	N/A	NO	DLBSL
	98-95-3	Nitrobenzene	ND	ND	MG/KG		0/16	2.5 - 2.5	2.5E+00	N/A	4.8E+00 C	N/A	N/A	NO	DLBSL
	99-35-4	1,3,5-Trinitrobenzene	ND	ND	MG/KG		0/16	2.5 - 2.5	2.5E+00	N/A	2.2E+02 N	N/A	N/A	NO	DLBSL
	99-65-0	1,3-Dinitrobenzene	ND	ND	MG/KG		0/16	2.5 - 2.5	2.5E+00	N/A	6.1E-01 N	N/A	N/A	YES	DLASL
	118-96-7	2,4,6-Trinitrotoluene	ND	ND	MG/KG		0/16	2.5 - 2.5	2.5E+00	N/A	3.6E+00 N	N/A	N/A	NO	DLBSL
	35572-78-2	2-Amino-4,6-dinitrotoluene	ND	ND	MG/KG		0/16	2.5 - 2.5	2.5E+00	N/A	1.5E+01 N	N/A	N/A	NO	DLBSL
	88-72-2	2-Nitrotoluene	ND	ND	MG/KG		0/16	2.5 - 2.5	2.5E+00	N/A	2.9E+00 C	N/A	N/A	NO	DLBSL
	99-08-1	3-Nitrotoluene	ND	ND	MG/KG		0/16	2.5 - 2.5	2.5E+00	N/A	6.1E-01 N	N/A	N/A	YES	DLASL
	19406-51-0	4-Amino-2,6-dinitrotoluene	ND	ND	MG/KG		0/16	2.5 - 2.5	2.5E+00	N/A	1.5E+01 N	N/A	N/A	NO	DLBSL
	99-99-0	4-Nitrotoluene	ND	ND	MG/KG		0/16	2.5 - 2.5	2.5E+00	N/A	2.4E+01 N	N/A	N/A	NO	DLBSL
	2691-41-0	HMX	ND	ND	MG/KG		0/16	2.5 - 2.5	2.5E+00	N/A	3.8E+02 N	N/A	N/A	NO	DLBSL
	55-63-0	Nitroglycerin	ND	ND	MG/KG		0/16	5 - 5	5.0E+00	N/A	6.1E-01 N	N/A	N/A	YES	DLASL
	14797-73-0	Perchlorate	8.4E-04 J	8.4E-04 J	MG/KG	VL-SS05-12B	1/16	0.0023 - 0.0031	8.4E-04	N/A	5.5E+00 N	N/A	N/A	NO	BSL
	78-11-5	PETN	ND	ND	MG/KG		0/16	5 - 5	5.0E+00	N/A	1.2E+01 N	N/A	N/A	NO	DLBSL
	121-82-4	RDX	ND	ND	MG/KG		0/16	2.5 - 2.5	2.5E+00	N/A	5.6E+00 C	N/A	N/A	NO	DLBSL
	479-45-8	Tetryl	ND	ND	MG/KG		0/16	2.5 - 2.5	2.5E+00	N/A	2.4E+01 N	N/A	N/A	NO	DLBSL
	7429-90-5	**Aluminum**	**7.5E+02**	**1.8E+04**	**MG/KG**	**VL-SS14-12B**	**16/16**	**9.1 - 250**	**1.8E+04**	**1.7E+04**	**7.7E+03 N**	**N/A**	**N/A**	**YES**	**ASL**
	7440-36-0	Antimony	2.5E-02 J	3.3E-01	MG/KG	VL-SS08-12B	14/16	0.18 - 0.2	3.3E-01	1.9E+00	3.1E+00 N	9.0E-01	NCSSL	NO	BSL
	7440-38-2	**Arsenic**	**2.8E-01 J**	**6.9E+00**	**MG/KG**	**VL-SS08-12B**	**16/16**	**0.46 - 0.5**	**6.9E+00**	**1.5E+00**	**3.9E-01 C**	**5.8E+00**	**NCSSL**	**YES**	**ASL**
	7440-39-3	Barium	2.4E+00	3.6E+01	MG/KG	VL-SS08-12B	16/16	0.091 - 0.5	3.6E+01	5.3E+01	1.5E+03 N	5.8E+02	NCSSL	NO	BSL
	7440-41-7	Beryllium	2.5E-02 J	3.7E-01	MG/KG	VL-SS08-12B	14/16	0.091 - 0.1	3.7E-01	3.3E-01	1.6E+01 N	6.3E+01	NCSSL	NO	BSL
	7440-43-9	Cadmium	4.3E-03 J	1.5E-01	MG/KG	VL-SS08-12B	16/16	0.046 - 0.05	1.5E-01	2.7E-01	7.0E+00 N	3.0E+00	NCSSL	NO	BSL
	7440-70-2	Calcium	6.8E+01	4.2E+03	MG/KG	VL-SS08-12B	14/16	46 - 50	4.2E+03	2.1E+04	N/A	N/A	N/A	NO	NUT
	18540-29-9	Chromium (hexavalent)	2.8E-01 J-	1.9E+00 J-	MG/KG	VL-SS02-12B	8/16	0.45 - 0.6	1.9E+00	2.7E+00	2.9E-01 C	3.8E+00	NCSSL	NO	BBK
	7440-47-3	Chromium	8.1E-01 J	1.6E+01 J	MG/KG	VL-SS08-12B	16/16	0.18 - 1	1.6E+01	2.4E+01	1.2E+04 N	N/A	N/A	NO	BSL
	7440-48-4	Cobalt	3.2E-02 J	1.6E+00	MG/KG	VL-SS08-12B	16/16	0.091 - 0.1	1.6E+00	1.1E+00	2.3E+00 N	9.0E-01	NCSSL	NO	BSL
	7440-50-8	Copper	3.1E-01	6.7E+00	MG/KG	VL-SS08-12B	16/16	0.18 - 0.2	6.7E+00	6.6E+00	3.1E+02 N	7.0E+02	NCSSL	NO	BSL
	7439-89-6	Iron	5.7E+02	9.0E+03	MG/KG	VL-SS08-12B	16/16	4.6 - 120	9.0E+03	1.5E+04	5.5E+03 N	1.5E+02	NCSSL	NO	BBK
	7439-92-1	Lead	2.8E+00	5.6E+01	MG/KG	VL-SS14-12B	16/16	0.093 - 1	5.6E+01	2.1E+01	4.0E+02 NL	2.7E+02	NCSSL	NO	BSL
	7439-95-4	Magnesium	3.2E+01 J	4.2E+02	MG/KG	VL-SS08-12B	16/16	46 - 50	4.2E+02	7.3E+02	N/A	N/A	N/A	NO	NUT
	7439-96-5	Manganese	1.9E+00	7.9E+01	MG/KG	VL-SS08-12B	16/16	0.18 - 5	7.9E+01	5.8E+01	1.8E+02 N	6.5E+01	NCSSL	NO	BSL
	7439-97-6	Mercury	9.0E-03 J	7.5E-02	MG/KG	VL-SS14-12B	16/16	0.045 - 0.05	7.5E-02	1.3E-01	2.3E+00 N	1.0E+00	NCSSL	NO	BSL
	7440-02-0	Nickel	7.4E-01 J	8.3E+00 J	MG/KG	VL-SS03D-12B	16/16	0.18 - 0.2	8.3E+00	8.9E+00	1.5E+02 N	1.3E+02	NCSSL	NO	BSL
	7440-09-7	Potassium	4.1E+01 J	4.7E+02	MG/KG	VL-SS08-12B	16/16	46 - 50	4.7E+02	2.0E+02	N/A	N/A	N/A	NO	NUT
	7782-49-2	Selenium	1.1E-01 J	1.2E+00	MG/KG	VL-SS08-12B : VL-SS12-12B	16/16	0.46 - 0.5	1.2E+00	2.1E+00	3.9E+01 N	2.1E+00	NCSSL	NO	BSL

TABLE F-1

Occurrence, Distribution, and Selection of Chemicals of Potential Concern

Site UXO-25 - Verona Loop PA/SI

MCIEAST -MCB CAMLEJ, North Carolina

Scenario Timeframe: Current/Future
Medium: Surface Soil
Exposure Medium: Surface Soil

Exposure Point	CAS Number	Chemical	Minimum [1] Concentration Qualifier	Maximum [1] Concentration Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration [2] Used for Screening	Background [3] Value	Screening [4] Toxicity Value	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for [5] Contaminant Deletion or Selection
	7440-22-4	Silver	4.4E-03 J	2.1E-02 J	MG/KG	VL-SS08-12B	9/16	0.091 - 0.1	2.1E-02	4.6E-01	3.9E+01 N	3.4E+00	NCSSL	NO	BSL
	7440-23-5	Sodium	6.7E+00 J	9.5E+01	MG/KG	VL-SS08-12B	7/16	46 - 50	9.5E+01	8.3E+01	N/A	N/A	N/A	NO	NUT
	7440-28-0	**Thallium**	**1.0E-02 J**	**1.3E-01**	**MG/KG**	**VL-SS08-12B : VL-SS12-12B**	**16/16**	**0.091 - 0.1**	**1.3E-01**	**N/A**	**7.8E-02 N**	**2.8E-01**	**NCSSL**	**YES**	**ASL**
	7440-62-2	Vanadium	2.5E+00 J	2.9E+01 J	MG/KG	VL-SS08-12B	16/16	0.091 - 0.5	2.9E+01	2.6E+01	3.9E+01 N	6.0E+00	NCSSL	NO	BSL
	7440-66-6	Zinc	1.3E+00 J	1.2E+02	MG/KG	VL-SS08-12B	16/16	1.8 - 50	1.2E+02	4.4E+01	2.3E+03 N	1.2E+03	NCSSL	NO	BSL

[1] Minimum/Maximum detected concentrations.

[2] Maximum concentration is used for screening.

[3] Background values are the background threshold values (BTVs) for surface soil data in undeveloped areas (combined soil types).
Background values are from Final Expanded Soil Background Study Report, Marine Corps Base Camp Lejeune, Jacksonville, North Carolina, CH2M HILL, August 2011.

[4] Oak Ridge National Laboratory (ORNL). May, 2012. Regional Screening Levels for Chemical Contaminants at Superfund Sites. [Online]. Adjusted (RSLs based on non-cancer (N) divided by 10) residential soil RSLs. Available: http://epa-prgs.ornl.gov/chemicals/index.shtml
RSL value for Chromium(III) used as surrogate for chromium.
The soil value of 400 mg/kg for lead is from the Revised Interim Soil Lead Guidance for CERCLA Sites and RCRA Corrective Action Facilities, USEPA, July 14, 1994.
RSL value for Mercury (inorganic salts) used as surrogate for mercury.

[5] Rationale Codes

Selection Reason:
- Above Screening Levels (ASL)
- Detection Limit Above Screening Level (DLASL), not quantitatively evaluated in HHRA

Deletion Reason:
- No Toxicity Information (NTX)
- Essential Nutrient (NUT)
- Below Screening Level (BSL)
- Detection Limit Below Screening Level (DLBSL)
- Below Background Value (BBK)

COPC = Chemical of Potential Concern
ARAR/TBC = Applicable or Relevant and Appropriate Requirement/ To Be Considered
J = Estimated Value
J- = Analyte present, value may be biased low, actual value may be higher
C = Carcinogenic
N = Noncarcinogenic
NCSSL = North Carolina Preliminary Soil Remediation Goal, June 2011
MG/KG = millograms per kilogram
N = Noncarcinogenic
N/A = Not available
ND = Non-detect
NL = Noncarcinogenic lead residential soil RSL not adjusted by dividing by 10.

TABLE B-1a

Risk Ratio Screening for Surface Soil, Maximum Detected Concentration

Site UXO-25 - Verona Loop PA/SI

MCIEAST -MCB CAMLEJ, North Carolina

Analyte	Detection Frequency	Maximum Detected Concentration (Qualifier)	Sample Location of Maximum Detected Concentration	Residential Soil RSL	Acceptable Risk Level	Corresponding Hazard Index[a]	Corresponding Cancer Risk[b]	Target Organ
Metals (mg/kg)								
Aluminum	16 / 16	1.8E+04	VL-SS14-12B	7.7E+04	1	0.2	N/A	Neurological, Developmental
Arsenic	16 / 16	6.9E+00	VL-SS08-12B	3.9E-01	1E-06	N/A	2E-05	N/A
Thallium	16 / 16	1.3E-01	VL-SS08-12B : VL-SS12-12B	7.8E-01	1	0.2	N/A	Hair
Cumulative Corresponding Hazard Index[c]						**0.4**		
Cumulative Corresponding Cancer Risk[d]							**2E-05**	

Total Neurological HI =	0.2
Total Developmental HI =	0.2
Total Hair HI =	0.2

Notes:

[a] Corresponding Hazard Index equals maximum detected concentration divided by the RSL divided by the acceptable risk level.

[b] Corresponding Cancer Risk equals maximum detected concentration divided by the RSL divided by the acceptable risk level.

[c] Cumulative Corresponding Hazard Index equals sum of Corresponding Hazard Indices for each constituent.

[d] Cumulative Corresponding Cancer Risk equals sum of Corresponding Cancer Risks for each constituent.

Constituent selected as COPC if it contributes to an overall Hazard Index by target organ greater than 0.5 or Cumulative Corresponding Cancer Risk greater than 5E-05 otherwise, constituent not selected as COPC.

Constituents selected as COPCs are indicated by shading.

COPC = Chemical of Potential Concern

HI = Hazard Index

J = Estimated Value

mg/kg = milligrams per kilogram

N/A = Not available/not applicable

TABLE B-2

Occurrence, Distribution, and Selection of Chemicals of Potential Concern

Site UXO-25 - Verona Loop PA/SI

MCIEAST -MCB CAMLEJ, North Carolina

Scenario Timeframe: Current/Future
Medium: Subsurface Soil
Exposure Medium: Subsurface Soil

Exposure Point	CAS Number	Chemical	Minimum [1] Concentration Qualifier	Maximum [1] Concentration Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration [2] Used for Screening	Background [3] Value	Screening [4] Toxicity Value	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for [5] Contaminant Deletion or Selection
Subsurface Soil	121-14-2	2,4-Dinitrotoluene	ND	ND	MG/KG		0/16	2.5 - 2.5	2.5E+00	N/A	1.6E+00 C	1.6E-03	NCSSL	YES	DLASL
	606-20-2	2,6-Dinitrotoluene	ND	ND	MG/KG		0/16	2.5 - 2.5	2.5E+00	N/A	6.1E+00 N	N/A	N/A	NO	DLBSL
	98-95-3	Nitrobenzene	ND	ND	MG/KG		0/16	2.5 - 2.5	2.5E+00	N/A	4.8E+00 C	N/A	N/A	NO	DLBSL
	99-35-4	1,3,5-Trinitrobenzene	ND	ND	MG/KG		0/16	2.5 - 2.5	2.5E+00	N/A	2.2E+02 N	N/A	N/A	NO	DLBSL
	99-65-0	1,3-Dinitrobenzene	ND	ND	MG/KG		0/16	2.5 - 2.5	2.5E+00	N/A	6.1E-01 N	N/A	N/A	YES	DLASL
	118-96-7	2,4,6-Trinitrotoluene	ND	ND	MG/KG		0/16	2.5 - 2.5	2.5E+00	N/A	3.6E+00 N	N/A	N/A	NO	DLBSL
	35572-78-2	2-Amino-4,6-dinitrotoluene	ND	ND	MG/KG		0/16	2.5 - 2.5	2.5E+00	N/A	1.5E+01 N	N/A	N/A	NO	DLBSL
	88-72-2	2-Nitrotoluene	ND	ND	MG/KG		0/16	2.5 - 2.5	2.5E+00	N/A	2.9E+00 C	N/A	N/A	NO	DLBSL
	99-08-1	3-Nitrotoluene	ND	ND	MG/KG		0/16	2.5 - 2.5	2.5E+00	N/A	6.1E-01 N	N/A	N/A	YES	DLASL
	19406-51-0	4-Amino-2,6-dinitrotoluene	ND	ND	MG/KG		0/16	2.5 - 2.5	2.5E+00	N/A	1.5E+01 N	N/A	N/A	NO	DLBSL
	99-99-0	4-Nitrotoluene	ND	ND	MG/KG		0/16	2.5 - 2.5	2.5E+00	N/A	2.4E+01 N	N/A	N/A	NO	DLBSL
	2691-41-0	HMX	ND	ND	MG/KG		0/16	2.5 - 2.5	2.5E+00	N/A	3.8E+02 N	N/A	N/A	NO	DLBSL
	55-63-0	Nitroglycerin	ND	ND	MG/KG		0/16	4.5 - 5	5.0E+00	N/A	6.1E-01 N	N/A	N/A	YES	DLASL
	14797-73-0	Perchlorate	ND	ND	MG/KG		0/16	0.0023 - 0.003	3.0E-03	N/A	5.5E+00 N	N/A	N/A	NO	DLBSL
	78-11-5	PETN	ND	ND	MG/KG		0/16	4.5 - 5	5.0E+00	N/A	1.2E+01 N	N/A	N/A	NO	DLBSL
	121-82-4	RDX	ND	ND	MG/KG		0/16	2.5 - 2.5	2.5E+00	N/A	5.6E+00 C	N/A	N/A	NO	DLBSL
	479-45-8	Tetryl	ND	ND	MG/KG		0/16	2.5 - 2.5	2.5E+00	N/A	2.4E+01 N	N/A	N/A	NO	DLBSL
	7429-90-5	Aluminum	4.1E+03	1.8E+04	MG/KG	VL-SB12-1-4-12B	16/16	9.2 - 500	1.8E+04	1.9E+04	7.7E+03 N	N/A	N/A	NO	BBK
	7440-36-0	Antimony	2.9E-02 J	1.7E-01 J	MG/KG	VL-SB08-1-4-12B	11/16	0.18 - 0.2	1.7E-01	1.1E+00	3.1E+00 N	9.0E-01	NCSSL	NO	BSL
	7440-38-2	Arsenic	4.5E-01 J	3.0E+00	MG/KG	VL-SB08-1-4-12B	16/16	0.46 - 0.5	3.0E+00	5.1E+00	3.9E-01 C	5.8E+00	NCSSL	NO	BBK
	7440-39-3	Barium	2.1E+00 J	2.6E+01 J	MG/KG	VL-SB07-1-4-12B	16/16	0.092 - 0.5	2.6E+01	2.8E+01	1.5E+03 N	5.8E+02	NCSSL	NO	BSL
	7440-41-7	Beryllium	2.2E-02 J	2.2E-01	MG/KG	VL-SB08-1-4-12B : VL-SB12-1-4-12B	16/16	0.092 - 0.1	2.2E-01	3.3E-01	1.6E+01 N	6.3E+01	NCSSL	NO	BSL
	7440-43-9	Cadmium	3.9E-03 J	6.9E-02	MG/KG	VL-SB08-1-4-12B	12/16	0.046 - 0.05	6.9E-02	2.1E-01	7.0E+00 N	3.0E+00	NCSSL	NO	BSL
	7440-70-2	Calcium	2.1E+01 J	3.0E+03	MG/KG	VL-SB08-1-4-12B	8/16	46 - 50	3.0E+03	1.5E+03	N/A	N/A	N/A	NO	NUT
	18540-29-9	**Chromium (hexavalent)**	**1.4E+00 J-**	**6.6E+00 J-**	**MG/KG**	**VL-SB11-1-4-12B**	**15/16**	**0.45 - 0.6**	**6.6E+00**	**3.7E+00**	**2.9E-01 C**	**3.8E+00**	**N/A**	**YES**	**ASL**
	7440-47-3	Chromium	4.6E+00	1.1E+01	MG/KG	VL-SB12-1-4-12B	16/16	0.18 - 1	1.1E+01	2.8E+01	1.2E+04 N	N/A	N/A	NO	BSL
	7440-48-4	Cobalt	1.4E-01	7.3E-01	MG/KG	VL-SB08-1-4-12B	16/16	0.092 - 0.1	7.3E-01	1.4E+00	2.3E+00 N	9.0E-01	NCSSL	NO	BSL
	7440-50-8	Copper	1.6E-01 J	3.3E+00	MG/KG	VL-SB08-1-4-12B	16/16	0.18 - 0.2	3.3E+00	6.1E+00	3.1E+02 N	7.0E+02	NCSSL	NO	BSL
	7439-89-6	Iron	1.0E+03	1.0E+04	MG/KG	VL-SB11-1-4-12B	16/16	4.6 - 250	1.0E+04	1.3E+04	5.5E+03 N	1.5E+02	NCSSL	NO	BBK
	7439-92-1	Lead	2.4E+00	1.8E+01	MG/KG	VL-SB08-1-4-12B	16/16	0.092 - 0.5	1.8E+01	1.1E+01	4.0E+02 NL	2.7E+02	NCSSL	NO	BSL
	7439-95-4	Magnesium	6.8E+01	4.5E+02	MG/KG	VL-SB12-1-4-12B	16/16	46 - 50	4.5E+02	7.8E+02	N/A	N/A	N/A	NO	NUT
	7439-96-5	Manganese	1.7E+00	3.1E+01	MG/KG	VL-SB08-1-4-12B	16/16	0.18 - 1	3.1E+01	1.8E+01	1.8E+02 N	6.5E+01	NCSSL	NO	BSL
	7439-97-6	Mercury	9.8E-03 J	3.6E-02 J	MG/KG	VL-SB12-1-4-12B	14/16	0.046 - 0.05	3.6E-02	8.5E-02	2.3E+00 N	1.0E+00	NCSSL	NO	BSL
	7440-02-0	Nickel	5.7E-01	2.9E+00	MG/KG	VL-SB12-1-4-12B	16/16	0.18 - 0.2	2.9E+00	7.1E+00	1.5E+02 N	1.3E+02	NCSSL	NO	BSL
	7440-09-7	Potassium	7.9E+01	5.4E+02	MG/KG	VL-SB12-1-4-12B	16/16	46 - 50	5.4E+02	6.2E+02	N/A	N/A	N/A	NO	NUT

TABLE F-2

Occurrence, Distribution, and Selection of Chemicals of Potential Concern

Site UXO-25 - Verona Loop PA/SI

MCIEAST -MCB CAMLEJ, North Carolina

Scenario Timeframe: Current/Future
Medium: Subsurface Soil
Exposure Medium: Subsurface Soil

Exposure Point	CAS Number	Chemical	Minimum [1] Concentration Qualifier	Maximum [1] Concentration Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration [2] Used for Screening	Background [3] Value	Screening [4] Toxicity Value	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for [5] Contaminant Deletion or Selection
	7782-49-2	Selenium	1.2E-01 J	7.4E-01	MG/KG	VL-SB08-1-4-12B	16/16	0.46 - 0.5	7.4E-01	7.4E-01	3.9E+01 N	2.1E+00	NCSSL	NO	BSL
	7440-22-4	Silver	4.7E-03 J	1.1E-02 J	MG/KG	VL-SB08-1-4-12B	7/16	0.092 - 0.1	1.1E-02	2.0E-01	3.9E+01 N	3.4E+00	NCSSL	NO	BSL
	7440-23-5	Sodium	6.6E+00 J	9.3E+01	MG/KG	VL-SB08-1-4-12B	7/16	46 - 50	9.3E+01	N/A	N/A	N/A	N/A	NO	NUT
	7440-28-0	**Thallium**	**1.5E-02 J**	**1.2E-01**	**MG/KG**	**VL-SB12-1-4-12B : VL-SB14-1-4-12B**	**16/16**	**0.092 - 0.1**	**1.2E-01**	**N/A**	**7.8E-02 N**	**2.8E-01**	**NCSSL**	**YES**	**ASL**
	7440-62-2	Vanadium	4.9E+00	2.5E+01	MG/KG	VL-SB12-1-4-12B	16/16	0.092 - 0.5	2.5E+01	3.6E+01	3.9E+01 N	6.0E+00	NCSSL	NO	BSL
	7440-66-6	Zinc	1.6E+00 J	4.4E+01	MG/KG	VL-SB08-1-4-12B	16/16	1.8 - 19	4.4E+01	1.4E+01	2.3E+03 N	1.2E+03	NCSSL	NO	BSL

[1] Minimum/Maximum detected concentrations.

[2] Maximum concentration is used for screening.

[3] Background values are the background threshold values (BTVs) for subsurface soil data in undeveloped areas (combined soil types).
Background values are from Final Expanded Soil Background Study Report, Marine Corps Base Camp Lejeune, Jacksonville, North Carolina, CH2M HILL, August 2011.

[4] Oak Ridge National Laboratory (ORNL). May, 2012. Regional Screening Levels for Chemical Contaminants at Superfund Sites. [Online]. Adjusted (RSLs based on non-cancer (N) divided by 10) residential soil RSLs. Available: http://epa-prgs.ornl.gov/chemicals/index.shtml
RSL value for Chromium(III) used as surrogate for chromium.
The soil value of 400 mg/kg for lead is from the Revised Interim Soil Lead Guidance for CERCLA Sites and RCRA Corrective Action Facilities, USEPA, July 14, 1994.
RSL value for Mercury (inorganic salts) used as surrogate for mercury.

[5] Rationale Codes

Selection Reason:
- Above Screening Levels (ASL)
- Detection Limit Above Screening Level (DLASL), not quantitatively evaluated in HHRA

Deletion Reason:
- No Toxicity Information (NTX)
- Essential Nutrient (NUT)
- Below Screening Level (BSL)
- Detection Limit Below Screening Level (DLBSL)
- Below Background Value (BBK)

COPC = Chemical of Potential Concern
ARAR/TBC = Applicable or Relevant and Appropriate Requirement/ To Be Considered
J = Estimated Value
J- = Analyte present, value may be biased low, actual value may be higher
C = Carcinogenic
N = Noncarcinogenic
NCSSL = North Carolina Preliminary Soil Remediation Goal, June 2011
MG/KG = millograms per kilogram
N = Noncarcinogenic
N/A = Not available
ND = Non-detect
NL = Noncarcinogenic lead residential soil RSL not adjusted by dividing by 10.

TABLE F-2a

Risk Ratio Screening for Subsurface Soil, Maximum Detected Concentration

Site UXO-25 - Verona Loop PA/SI

MCIEAST -MCB CAMLEJ, North Carolina

Analyte	Detection Frequency	Maximum Detected Concentration	Sample Location of Maximum Detected Concentration	Residential Soil RSL	Acceptable Risk Level	Corresponding Hazard Index[a]	Corresponding Cancer Risk[b]	Target Organ
Metals (mg/kg)								
Chromium (hexavalent)	15 / 16	6.6E+00 J-	VL-SB11-1-4-12B	2.9E-01	1E-06	N/A	2E-05	N/A
Thallium	16 / 16	1.2E-01	VL-SB12-1-4-12B : VL-SB14-1-4-12B	7.8E-01	1	0.2	N/A	Hair
Cumulative Corresponding Hazard Index[c]						**0.2**		
Cumulative Corresponding Cancer Risk[d]							**2E-05**	
							Total Hair HI =	0.2

Notes:

[a] Corresponding Hazard Index equals maximum detected concentration divided by the RSL divided by the acceptable risk level.

[b] Corresponding Cancer Risk equals maximum detected concentration divided by the RSL divided by the acceptable risk level.

[c] Cumulative Corresponding Hazard Index equals sum of Corresponding Hazard Indices for each constituent.

[d] Cumulative Corresponding Cancer Risk equals sum of Corresponding Cancer Risks for each constituent.

Constituent selected as COPC if it contributes to an overall Hazard Index by target organ greater than 0.5 or Cumulative Corresponding Cancer Risk greater than 5E-05 otherwise, constituent not selected as COPC.

Constituents selected as COPCs are indicated by shading.

COPC = Chemical of Potential Concern

HI = Hazard Index

J = Estimated Value

mg/kg = milligrams per kilogram

N/A = Not available/not applicable

TABLE F-3

Occurrence, Distribution, and Selection of Chemicals of Potential Concern

Site UXO-25 - Verona Loop PA/SI

MCIEAST -MCB CAMLEJ, North Carolina

Scenario Timeframe: Current/Future
Medium: Groundwater
Exposure Medium: Groundwater

Exposure Point	CAS Number	Chemical	Minimum [1] Concentration Qualifier	Maximum [1] Concentration Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration [2] Used for Screening	Background [3] Value	Screening [4] Toxicity Value	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for [5] Contaminant Deletion or Selection
Groundwater	121-14-2	2,4-Dinitrotoluene	ND	ND	UG/L		0/2	5 - 5	5.0E+00	N/A	2.0E-01 C	N/A	N/A	YES	DLASL
	606-20-2	2,6-Dinitrotoluene	ND	ND	UG/L		0/2	5 - 5	5.0E+00	N/A	1.5E+00 N	N/A	N/A	YES	DLASL
	98-95-3	Nitrobenzene	ND	ND	UG/L		0/2	5 - 5	5.0E+00	N/A	1.2E-01 C	N/A	N/A	YES	DLASL
	99-35-4	1,3,5-Trinitrobenzene	ND	ND	UG/L		0/2	5 - 5	5.0E+00	N/A	4.6E+01 N	N/A	N/A	NO	DLBSL
	99-65-0	1,3-Dinitrobenzene	ND	ND	UG/L		0/2	5 - 5	5.0E+00	N/A	1.5E-01 N	N/A	N/A	YES	DLASL
	118-96-7	2,4,6-Trinitrotoluene	ND	ND	UG/L		0/2	5 - 5	5.0E+00	N/A	7.6E-01 N	N/A	N/A	YES	DLASL
	35572-78-2	2-Amino-4,6-dinitrotoluene	ND	ND	UG/L		0/2	5 - 5	5.0E+00	N/A	3.0E+00 N	N/A	N/A	YES	DLASL
	88-72-2	2-Nitrotoluene	ND	ND	UG/L		0/2	5 - 5	5.0E+00	N/A	2.7E-01 C	N/A	N/A	YES	DLASL
	99-08-1	3-Nitrotoluene	ND	ND	UG/L		0/2	5 - 5	5.0E+00	N/A	1.3E-01 N	N/A	N/A	YES	DLASL
	19406-51-0	4-Amino-2,6-dinitrotoluene	ND	ND	UG/L		0/2	5 - 5	5.0E+00	N/A	3.0E+00 N	N/A	N/A	YES	DLASL
	99-99-0	4-Nitrotoluene	ND	ND	UG/L		0/2	5 - 5	5.0E+00	N/A	3.7E+00 C	N/A	N/A	YES	DLASL
	2691-41-0	HMX	ND	ND	UG/L		0/2	5 - 5	5.0E+00	N/A	7.8E+01 N	N/A	N/A	NO	DLBSL
	55-63-0	Nitroglycerin	ND	ND	UG/L		0/2	5 - 5	5.0E+00	N/A	1.5E-01 N	N/A	N/A	YES	DLASL
	14797-73-0	Perchlorate	ND	ND	UG/L		0/2	0.2 - 0.2	2.0E-01	N/A	1.1E+00 N	N/A	N/A	NO	DLBSL
	78-11-5	PETN	ND	ND	UG/L		0/2	10 - 10	1.0E+01	N/A	3.0E+00 N	N/A	N/A	YES	DLASL
	121-82-4	RDX	ND	ND	UG/L		0/2	5 - 5	5.0E+00	N/A	6.1E-01 C	N/A	N/A	YES	DLASL
	479-45-8	Tetryl	ND	ND	UG/L		0/2	5 - 5	5.0E+00	N/A	6.3E+00 N	N/A	N/A	NO	DLBSL
	7429-90-5	Aluminum	1.3E+02	1.5E+02	UG/L	VL-GW02-12B	2/2	100 - 100	1.5E+02	1.4E+04	1.6E+03 N	N/A	N/A	NO	BSL
	7440-36-0	Antimony	ND	ND	UG/L		0/2	2 - 2	2.0E+00	3.9E+00	6.0E-01 N	6.0E+00	MCL	NO	DLBBK
	7440-38-2	Arsenic	2.6E-01 J	2.6E-01 J	UG/L	VL-GW01-12B	1/2	5 - 5	2.6E-01	9.8E+00	4.5E-02 C	1.0E+01	MCL, 15A NCAC 2L	NO	BBK
	7440-39-3	Barium	1.9E+01	4.3E+01	UG/L	VL-GW02-12B	2/2	2 - 2	4.3E+01	3.6E+02	2.9E+02 N	2.0E+03	MCL	NO	BSL
												7.0E+02	15A NCAC 2L		
	7440-41-7	Beryllium	1.2E-01 J	1.2E-01 J	UG/L	VL-GW02-12B	1/2	1 - 1	1.2E-01	8.7E-01	1.6E+00 N	4.0E+00	MCL	NO	BSL
	7440-43-9	Cadmium	5.1E-02 J	5.1E-02 J	UG/L	VL-GW01-12B	1/2	0.2 - 0.2	5.1E-02	N/A	6.9E-01 N	5.0E+00	MCL	NO	BSL
												2.0E+00	15A NCAC 2L		
	7440-70-2	Calcium	2.3E+03	3.4E+03	UG/L	VL-GW01-12B	2/2	500 - 500	3.4E+03	1.8E+05	N/A C	N/A	N/A	NO	NUT
	18540-29-9	Chromium (hexavalent)	ND	ND	UG/L		0/2	10 - 10	1.0E+01	N/A	3.1E-02 C	N/A	N/A	YES	DLASL
	7440-47-3	Chromium	2.2E-01 J	4.7E-01 J	UG/L	VL-GW02-12B	2/2	1 - 1	4.7E-01	1.7E+01	1.6E+03 N	1.0E+02	MCL	NO	BSL
												1.0E+01	15A NCAC 2L		
	7440-48-4	Cobalt	5.6E-01 J	1.3E+00	UG/L	VL-GW02-12B	2/2	1 - 1	1.3E+00	3.4E+00	4.7E-01 N	N/A	N/A	NO	BBK
	7440-50-8	Copper	2.5E-01 J	3.8E-01 J	UG/L	VL-GW02-12B	2/2	1 - 1	3.8E-01	6.6E+00	6.2E+01 N	1.3E+03	MCL	NO	BSL
												1.0E+03	15A NCAC 2L		
	7439-89-6	Iron	6.8E+02	1.1E+03	UG/L	VL-GW02-12B	2/2	20 - 20	1.1E+03	1.6E+04	1.1E+03 N	3.0E+02	15A NCAC 2L	NO	BBK
	7439-92-1	Lead	1.7E-01 J	1.9E-01 J	UG/L	VL-GW01-12B	2/2	1 - 1	1.9E-01	8.9E+00	1.5E+01	1.5E+01	MCL, 15A NCAC 2L	NO	BSL
	7439-95-4	Magnesium	6.1E+02	7.8E+02	UG/L	VL-GW01-12B	2/2	500 - 500	7.8E+02	1.4E+04	N/A	N/A	N/A	NO	NUT
	7439-96-5	Manganese	1.8E+01	4.2E+01	UG/L	VL-GW02-12B	2/2	2 - 2	4.2E+01	1.8E+02	3.2E+01 N	5.0E+01	15A NCAC 2L	NO	BBK
	7439-97-6	**Mercury**	**4.6E-01**	**4.6E-01**	**UG/L**	**VL-GW02-12B**	**1/2**	**0.2 - 0.2**	**4.6E-01**	**N/A**	**4.3E-01 N**	**2.0E+00**	**MCL**	**YES**	**ASL**
												1.0E+00	**15A NCAC 2L**		

TABLE F-3

Occurrence, Distribution, and Selection of Chemicals of Potential Concern

Site UXO-25 - Verona Loop PA/SI

MCIEAST -MCB CAMLEJ, North Carolina

Scenario Timeframe: Current/Future
Medium: Groundwater
Exposure Medium: Groundwater

Exposure Point	CAS Number	Chemical	Minimum [1] Concentration Qualifier	Maximum [1] Concentration Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration [2] Used for Screening	Background [3] Value	Screening [4] Toxicity Value	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for [5] Contaminant Deletion or Selection
	7440-02-0	Nickel	9.9E-01 J	2.6E+00	UG/L	VL-GW02-12B	2/2	1 - 1	2.6E+00	1.2E+01	3.0E+01 N	1.0E+02	15A NCAC 2L	NO	BSL
	7440-09-7	Potassium	5.0E+02	1.3E+03	UG/L	VL-GW02-12B : VL-GW02D-12B	2/2	100 - 100	1.3E+03	5.6E+03	N/A	N/A	N/A	NO	NUT
	7782-49-2	Selenium	6.3E-01 J	6.3E-01 J	UG/L	VL-GW02D-12B	1/2	5 - 5	6.3E-01	N/A	7.8E+00 N	5.0E+01	MCL	NO	BSL
												2.0E+01	15A NCAC 2L		
	7440-22-4	Silver	ND	ND	UG/L		0/2	0.5 - 0.5	5.0E-01	7.2E-01	7.1E+00 N	2.0E+01	15A NCAC 2L	NO	DLBSL
	7440-23-5	Sodium	5.0E+03	9.3E+03	UG/L	VL-GW02-12B	2/2	500 - 500	9.3E+03	2.3E+04	N/A	N/A	N/A	NO	NUT
	7440-28-0	Thallium	ND	ND	UG/L		0/2	0.2 - 0.2	2.0E-01	N/A	1.6E-02 N	2.0E+00	MCL	YES	DLASL
	7440-62-2	Vanadium	3.3E-01 J	4.0E-01 J	UG/L	VL-GW01-12B	2/2	1 - 1	4.0E-01	2.7E+01	7.8E+00 N	N/A	N/A	NO	BSL
	7440-66-6	Zinc	1.0E+01	3.5E+01 J	UG/L	VL-GW02D-12B	2/2	10 - 10	3.5E+01	4.1E+01	4.7E+02 N	1.0E+03	15A NCAC 2L	NO	BSL

[1] Minimum/Maximum detected concentration. Unfiltered results for metals since in general no significant difference between filtered and unfiltered results.

[2] Maximum concentration is used for screening. If chemical was not detected, the maximum detection limit is used for screening.

[3] Background values are the background threshold values (BTVs) shallow groundwater concentrations. Background values are from Draft Expanded Groundwater Background Study Report, Marine Corps Base Camp Lejeune, Jacksonville, North Carolina, CH2M Hill, September 2011.

[4] Oak Ridge National Laboratory (ORNL). May, 2012. Regional Screening Levels for Chemical Contaminants at Superfund Sites. http://epa-prgs.ornl.gov/chemicals/index.shtml. Adjusted (noncarcinogenic RSLs adjusted by dividing by 10) tap water RSLs.
RSL value for chromium(VI) used as surrogate for chromium.
RSL value for mercury (mercuric chloride) used as surrogate for mercury.
The tap water value of 15 ug/L for lead is the action level provided in the Drinking Water Regulations and Health Advisories.

[5] Rationale Codes

Selection Reason: Above Screening Levels (ASL)
Detection Limit Above Screening Level (DLASL), not quantitatively evaluated in HHRA

Deletion Reason: No Toxicity Information (NTX)
Essential Nutrient (NUT)
Below Screening Level (BSL)
Detection Limit Below Screening Level (DLBSL)
Below Background Value (BBK)
Detection Limit Below Background Screening Level (DLBBK)

COPC = Chemical of Potential Concern
ARAR/TBC = Applicable or Relevant and Appropriate Requirement/ To Be Considered
MCL = Maximum Contaminant Level from EPA's National Primary Drinking Water Standards
15A NCAC 2L = North Carolina Classifications and Groundwater Quality Standards, Amended January 2010.
J = Estimated Value
C = Carcinogenic
N = Noncarcinogenic
N/A = Not applicable/not available
ND = Not detected
UG/L = micrograms per liter

TABLE F-3a

Risk Ratio Screening for Groundwater, Maximum Detected Concentration

Site UXO-25 - Verona Loop PA/SI

MCIEAST -MCB CAMLEJ, North Carolina

Analyte	Detection Frequency	Maximum Detected Concentration (Qualifier)	Sample Location of Maximum Detected Concentration	Residential Soil RSL	Acceptable Risk Level	Corresponding Hazard Index[a]	Corresponding Cancer Risk[b]	Target Organ
Metals (ug/L)								
Mercury	1 / 2	4.6E-01	VL-GW02-12B	4.3E+00	1	0.1	N/A	Immune System
Cumulative Corresponding Hazard Index[c]						**0.1**		
Cumulative Corresponding Cancer Risk[d]							**N/A**	

Total Immune System HI = 0.1

Notes:

[a] Corresponding Hazard Index equals maximum detected concentration divided by the RSL divided by the acceptable risk level.

[b] Corresponding Cancer Risk equals maximum detected concentration divided by the RSL divided by the acceptable risk level.

[c] Cumulative Corresponding Hazard Index equals sum of Corresponding Hazard Indices for each constituent.

[d] Cumulative Corresponding Cancer Risk equals sum of Corresponding Cancer Risks for each constituent.

Constituent selected as COPC if it contributes to an overall Hazard Index by target organ greater than 0.5 or Cumulative Corresponding Cancer Risk greater than 5E-05 otherwise, constituent not selected as COPC.

Constituents selected as COPCs are indicated by shading.

COPC = Chemical of Potential Concern

HI = Hazard Index

J = Estimated Value

mg/kg = milligrams per kilogram

N/A = Not available/not applicable

Appendix G
Ecological Risk Screening Results

CHECKLIST FOR ECOLOGICAL ASSESSMENTS/SAMPLING

I. SITE LOCATION

1. Site Name_____UXO-25 - Verona Loop_____
   US EPA ID Number _____
   Location Marine Corps Installations East - Marine Corps Base Camp Lejeune (MCIEAST-MCB CAMLEJ)
   County Onslow_____ City Jacksonville_____ State NC_____

2. Latitude___34°40'08.36" N_____ Longitude__77°28'14.70" W_____

3. Attach site maps, including a topographical map, a diagram which illustrates the layout of the facility (e.g., site boundaries, structures, etc.), and maps showing all habitat areas identified in Section III of the checklist. Also, include maps which illustrate known and suspected release areas, sampling locations and any other important features, if available.

   Figures 3-3 and **3-4** of this report illustrates the site boundaries and sampling locations.

II. SITE CHARACTERIZATION

1. Indicate the approximate area of the site (i.e., acres or sq. ft.) approximately 25 acres.

2. Is this the first site visit? ☐ Yes X No Sampling was conducted in April 2012.
   If no, attach trip report of previous site visit(s), if available.

3. Are aerial or other site photographs available? X Yes ☐ No
   If yes, please attach any available photo(s) to the site map to the report.
   Figure 1-2 of this report.

4. Provide an approximate breakdown of the land uses on the site:

_____% Heavy Industrial	_____% Light Industrial	_____% Urban
_____% Residential	_____%Rural	_____% Agricultural[b]
_____% Recreational[a]	_100_% Undisturbed	_____% Other[c]

[a]For recreational areas, please describe the use of the area (e.g., park, playing field, etc).
_____

[b]For agricultural areas, please list the crops and/or livestock which are present.
_____

[c]For areas designated as "other," please describe the use of the area.
_____

5. Provide an approximate breakdown of the land uses in the area surrounding the site.
   Indicate the radius (in miles) of the area described: _____0.5 mile radius_____

_____% Heavy Industrial	__5__% Light Industrial	____% Urban
_25__% Residential	_____% Rural	____% Agricultural[b]
_____% Recreational[a]	__75_% Undisturbed	____% Other [c]

[a]For recreational areas, please describe the use of the area (e.g., park, playing field, golf course, etc).

_____

[b]For agricultural areas, please list the crops and/or livestock which are present.

_____

[c]For areas designated as "other," please describe the use of the area.

_____

6. Has any movement of soil taken place at the site? ☐ Yes X No
If yes, indicate the likely source of the disturbance, (e.g., erosion, agricultural, mining, industrial activities, removals, etc.) degree of disturbance, and estimate when these events occurred.

7. Do any sensitive environmental areas exist adjacent to or in proximity to the site, (e.g. Federal and State parks, National and State monuments, wetlands)? *Remember, flood plains and wetlands are not always obvious; do not answer "no" without confirming information. See Table 1 for a list of contacts.* Wetlands associated with Mill Run Creek are located immediately east of the UXO 25 Verona Loop site and U.S. Route 17.

   Please provide the source(s) of information used to identify these sensitive areas, and indicate their general location on the site map.

   MCIEAST-MCB CAMLEJ GIS Layer for Wetlands (National Wetlands Inventory [NWI])

   United States Marine Corps (USMC). 2006. *Integrated Natural Resource Management Plan (INRMP) 2007-2011, Marine Corps Base Camp Lejeune, Onslow County, North Carolina*. November.

8. What type of facility is located at the site?

   □ Chemical □ Manufacturing □ Mixing

   □ Waste Disposal X Other (specify)
   The site is predominately forested.

9. Identify the contaminants of potential concern (COPCs) at the site. If known, include the maximum contaminant levels. Please indicate the source of data cited (e.g., RFI, confirmatory sampling, etc).
   Metals and explosives were detected in the surface soil. Metals were detected in subsurface soil and groundwater.

10. Check any potential routes of off-site migration of contaminants observed at the site:

X Swales □ Depressions X Drainage Ditches

X Runoff □ Windblown Particulates □ Vehicular Traffic

X Other (specify): Groundwater

11. Indicate the approximate depth to groundwater (in feet below ground surface [(bgs)].
Depth to groundwater ranges from approximately 5 to 7 feet bgs.

12. Indicate the direction of groundwater flow (e.g., north, southeast, etc.)
Groundwater likely flows east toward Mill Run Creek (**Figure F-1**), however, only two surficial aquifer wells were installed on site so there is not enough information available to confirm.

13. Is the direction of surface runoff apparent from site observations? X Yes ☐ No
If yes, to which of the following does the surface runoff discharge? Indicate all that apply.

X Surface water (Drainage ditches) X Groundwater □ Sewer

□ Collection Impoundment

14. Is there a navigable water body or tributary to a navigable water body?
X Yes □ No

15. Is there a water body anywhere on or in the vicinity of the site? If yes, also complete Section III.B.1: Aquatic Habitat Checklist -- Non-Flowing Systems and/or Section III.B.2: Aquatic Habitat Checklist -- Flowing Systems.

X Yes Drainage ditch in the southern portion of the site ☐ No

16. Is there evidence of flooding? X Yes ☐ No
Wetlands and flood plains are not always obvious. Do not answer "no" without confirming information. If yes, complete Section III.C: Wetland Habitat Checklist.

17. If a field guide was used to aid any of the identifications, please provide a reference. Also, estimate the time spent identifying fauna. (Use a blank sheet if additional space is needed for text.)

18. Are any threatened and/or endangered species (plant or animal) known to inhabit the area of the site? □ Yes X No
If yes, you are required to verify this information with the U.S. Fish and Wildlife Service or other appropriate agencies (see Table 1 for a list of contacts). If species' identities are known, please list them next.

19. Record weather conditions at the site at the time of the site visit when information for completion of this checklist was prepared:

DATE April 2012

Temperature °F) 70

Wind (direction/speed): NA

Cloud Cover: Partly cloudy

Normal daily high temperature (°C/°F):

Precipitation (rain, snow):

20. Describe reasonable and likely future land and/or water use(s) at the site.
The future land use for UXO 25-Verona Loop Site is unknown at this time.

21. Describe the historical uses of the site. Include information on chemical releases that may have occurred as a result of previous land uses. For each chemical release, provide information on the form of the chemical released (i.e., solid, liquid, vapor) and the known or suspected causes or mechanism of the release (i.e., spills, leaks, material disposal, dumping, explosion, etc.).
Site UXO-25 consists of those portions of two former ranges, the Impact Area "M" range and the M-16, Outdoor Classroom range, that are located west of U.S. Route 17 (**Figure 1-3**). During the timeframe the ranges were in use, U.S. Route 17 was located west of the range areas. Relocation of U.S. Route 17 in 1999 left approximately 25 acres of the former ranges to the west of U.S. Route 17. This 25-acre area west of U.S. Route 17 is bounded by the Old U.S. Route 17, which borders residential areas of the Verona Township.

United States Army Corps of Engineers (USACE). 2001a. *Final Range Identification and Preliminary Range Assessment, Marine Corps Base Camp Lejeune, Onslow, North Carolina. St. Louis District*. December.

USACE. 2001b. *Archives Search Report, Marine Corps Base Camp Lejeune, Onslow County, North Carolina*. St. Louis District. December.

22. Identify the media (e.g., soil [surface or subsurface], surface water, air, groundwater) which are known or suspected to contain COCs.
Metals and explosives were detected in surface soil. Metals were detected in subsurface soil and groundwater.

II.A. SUMMARY OF OBSERVATIONS AND SITE SETTING

Include information on significant source areas and migration pathways that are likely to constitute complete exposure pathways.

Overland runoff to surface water, leaching from soil to groundwater, and groundwater discharge to surface water are the migration pathways that are anticipated to result in complete ecological exposure pathways.

Checklist Completed by__Sara Kent_____

Affiliation__CH2M HILL_____

Author Assisted by____ _____

Date__08/06/12_____

III. HABITAT EVALUATION

III.A Terrestrial Habitat Checklist

III.A.1 Wooded

Are any wooded areas on or adjacent to the site? X Yes ☐ No

If yes, indicate the wooded area on the attached site map and answer the following questions. If more than one wooded area is present on or adjacent to the site, make additional copies of the following questions and fill out for each individual wooded area. Distinguish between wooded areas by using names or other designations, and clearly identify each area on the site map.
If no, proceed to Section III.A.2: Shrub/Scrub

Wooded Area Questions

X On-site ☐ Off-site

Name or Designation:

1. Estimate the approximate size of the wooded area (25 acres)
Please identify what information was used to determine the wooded area of the site (e.g., direct observation, photos, etc). Based on field observations and aerial photography available through Google Earth

2. Indicate the dominant type of vegetation in the wooded area. Provide photographs, if available.
   - ❑ Evergreen
   - ❑ Deciduous
   - X Mixed

   Dominant plant species, if known: Loblolly pine (*Pinus taeda*) and sweet gum (*Liquidambar styraciflua*)

3. Estimate the vegetation density of the wooded area.

- ❑ Dense (i.e., greater than 75% vegetation)
- X Moderate (i.e., 25% to 75% vegetation)
- ❑ Sparse (i.e., less than 25% vegetation)

4. Indicate the predominant size of the trees at the site. Use diameter at breast height.

- ❑ 0-6 inches
- ❑ 6-12 inches
- ❑ >12 inches
- X No single size range is predominant

5. Specify type of understory present, if known. Provide a photograph, if available. Understory is dominated by saplings and herbaceous and woody vine species (see photograph above).

III.A.2 Shrub/Scrub

Are any shrub/scrub areas on or adjacent to the site? ☐ Yes X No

If yes, indicate the shrub/scrub area on the attached site map and answer the following questions. If more than one shrub/scrub area is present on or adjacent to the site, make additional copies of the following questions and fill out for each individual shrub/scrub area. Distinguish between shrub/scrub areas, using names or other designations, and clearly identify each area on the site map.
If no, proceed to Section III.A.3: Open Field

III.A.3 Open Field

Are any open field areas on or adjacent to the site? X Yes ☐ No

If yes, indicate the open field area on the attached site map and answer the following questions. If more than one open field area is present on or adjacent to the site, make additional copies of the following questions and fill out for each individual open field area. Distinguish between open field areas, using names or other designations, and clearly identify each area on the site map.
If no, proceed to Section III.A.4: Miscellaneous

Open Field Area Questions

☐ On-site X Off-site

Name or Designation: UXO 25 – Verona Loop

1. Estimate the approximate size of the open field area (1 acre) Please identify what information was used to determine the open field area of the site. **Figure 1-2** and site photos taken during field activities. Open field area is located immediately south of site.

2. Indicate the dominant type of vegetation present, if known. Dominant species unknown

3. Estimate the vegetation density of the open field area.

X Dense (i.e., greater than 75% vegetation)
❑ Moderate (i.e., 25% to 75% vegetation)
❑ Sparse (i.e., less than 25% vegetation)

4. Indicate the approximate average height of the dominant plant: 6-12 inches

III.A.4 Miscellaneous

Are other types of terrestrial habitats present at the site, other than woods, scrub/shrub and open field? ☐ Yes X No

If yes, indicate the area on the attached site map and answer the following questions. If more than one of these areas are present on or adjacent to the site, make additional copies of the following questions and fill out for each individual area. Distinguish between areas by using names or other designations. Clearly identify each area on the site map. If no, proceed to Section III.B: Aquatic Habitats.

III.B Aquatic Habitats

Note: Aquatic systems are often associated with wetland habitats. Please refer to Section III.C, Wetland Habitat Checklist.

III.B.1 Non-Flowing Systems

Are any non-flowing aquatic features (such as ponds or lakes) located at or adjacent to the site?

□ Yes X No

If yes, indicate the aquatic feature on the attached site map and answer the following questions regarding the non-flowing aquatic features. If more than one non-flowing aquatic feature is present on or adjacent to the site, make additional copies of the following questions and fill out for each individual aquatic feature. Distinguish between aquatic features by using names or other designations. Clearly identify each area on the site map.

If no, proceed to Section III.B.2: Flowing Systems

III.B.2 Flowing Systems

Note: Aquatic systems are often associated with wetland habitats. Please refer to Section III.C, Wetland Habitat Checklist.

Are any flowing aquatic features (such as streams or rivers) located at or adjacent to the site?

X Yes □ No

If yes, indicate the system on the attached site map and answer the following questions regarding the flowing system. If more than one flowing system is present on or adjacent to the site, make additional copies of the following questions and complete one set for each individual aquatic feature. Distinguish between flowing systems by using names or other designation. Clearly identify each area on the site map

If no, proceed to Section III.C: Wetlands Habitats.

Flowing Aquatic Systems Questions

X On-site □ Off-site

Name or Designation: Un-named Drainage Ditch

1. Indicate the type of flowing aquatic feature present.

- ❑ River
- X Stream/Creek/Brook
- ❑ Intermittent stream
- ❑ Artificially created (ditch, etc.)
- ❑ Channeling
- ❑ Other (specify)

2. For natural systems, are there any indicators of physical alteration (e.g., channeling, debris, etc.)? X Yes □ No
   If yes, please describe the indicators observed. The stream appears to be dug out and channelized

3. Indicate the general composition of the bottom substrate.

□ Bedrock	X Sand (course)	□ Concrete
□ Boulder (>10 in.)	X Silt (fine)	□ Debris
□ Cobble (2.5 - 10 in.)	□ Clay (slick)	X Detritus
□ Gravel (0.1 - 2.5 in.)	□ Muck (fine/black)	□ Marl (Shells)

□ Other (please specify):_____

4. Describe the condition of the bank (e.g., height, slope, extent of vegetative cover).

   Incised, vertical banks approximately 3 feet deep.

5. Is the system influenced by tides? □ Yes X No
   What information was used to make this determination?
   Proximity to the New River. The Verona Loop site is not located in the vicinity of the new River.

6. Is the flow intermittent? □ Yes X No
   If yes, please note the information used to make this determination.

7. Is there a discharge from the site to the water body? X Yes □ No
   If yes, describe the origin of each discharge and its migration path.
   Groundwater and surface water discharge from the UXO-25 Verona Loop site.

8. Indicate the discharge point of the water body. Specify name of the discharge, if known.
   The drainage feature flows into a culvert under U.S. Route 17 that discharges to Mill Run Creek located east of the site.

9. Identify any field measurements and observations of water quality that were made. Provide the measurement and the units of measure in the appropriate space below: Not measured.
   _____ Width (ft.)
   _____ Depth (average)
   _____ Velocity (specify units):_____
   _____ Temperature (depth of water where the reading was taken)_____
   _____ pH
   _____ Dissolved oxygen
   _____ Salinity
   _____ Turbidity (clear, slightly turbid, turbid, opaque) (Secchi disk depth_____)
   _____ Other (specify)

10. Describe observed color and area of coloration. None observed

11. Is any aquatic vegetation present? □ Yes X No
    If yes, please identify the type of vegetation present, if known.

    □ Emergent □ Submergent □ Floating

12. Mark the flowing water system on the attached site map.

13. What observations were made at the water body regarding the presence and/or absence of benthic macroinvertebrates, fish, birds, mammals, etc?
    None were observed during the field investigation.

III.C Wetland Habitats

Are any wetland[1] areas such as marshes or swamps on or adjacent to the site?

X Yes □ No

If yes, indicate the wetland area on the attached site map and answer the following questions regarding the wetland area. If more than one wetland area is present on or adjacent to the site, make additional copies of the following questions and fill out one for each individual wetland area. Distinguish between wetland areas by using names or other designations (such as location). Clearly identify each area on the site map. Also, obtain and attach a National Wetlands Inventory Map (or maps) to illustrate each wetland area.

Identify the sources of the observations and information (e.g., National Wetland Inventory, Federal or State Agency, USGS topographic maps) used to make the determination whether or not wetland areas are present.

United States Marine Corps (USMC). 2006. *Integrated Natural Resource Management Plan (INRMP) 2007-2011, Marine Corps Base Camp Lejeune, Onslow County, North Carolina*. November.

MCIEAST-MCB CAMLEJ GIS Layer for Wetlands (NWI)

If no wetland areas are present, proceed to Section III.D: Sensitive Environments and Receptors.

Wetland Area Questions

□ On-site X Off-site

Name or Designation: Wetlands occur immediately east of the UXO 25 Verona Loop site and U.S. Route 17.

1. Indicate the approximate area of the wetland (acres or ft.^{2}) The NWI map indicates wetlands, associated with Mill Run Creek, are present in the area east of U.S. Route 17. A wetland delineation has not been conducted by CH2M HILL personnel for this area to identify the acreage, but wetland habitats were observed during the site visits (**Figure F-1**).

2. Identify the type(s) of vegetation present in the wetland. Based on NWI maps

   - ❑ Submergent (i.e., underwater) vegetation
   - ❑ Emergent (i.e., rooted in the water, but rising above it) vegetation
   - ❑ Floating vegetation

[1]Wetlands are defined in 40 CFR §232.2 as " Areas inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances does support, a prevalence of vegetation typically adapted for life in saturated soil conditions." Examples of typical wetlands plants include: cattails, cordgrass, willows and cypress trees. National wetland inventory maps may be available at http:\\nwi.fws.gov. Additional information on wetland delineation criteria is also available from the Army Corps of Engineers.

X Scrub/shrub
X Wooded
❑ Other (Please describe):_____

3. Provide a general description of the vegetation present in and around the wetland (height, color, etc). Provide a photograph of the known or suspected wetlands, if available. Observations were not recorded.

4. Estimate the vegetation density of the wetland area. Observations were not recorded.

❑ Dense (i.e., greater than 75% vegetation)
❑ Moderate (i.e., 25% to 75% vegetation)
❑ Sparse (i.e., less than 25% vegetation)

5. Is standing water present? □ Yes □ No Observations were not recorded.
If yes, is the water primarily: □ Fresh X Brackish
Indicate the approximate area of the standing water ($ft.^2$): Unknown
Indicate the approximate depth of the standing water, if known (ft. or in.) Unknown

6. Identify any field measurements and observations of water quality that were made. Provide the measurement and the units of measure in the appropriate space below: Observations were not recorded.

_____ Area
_____ Depth (average)
_____ Temperature (depth of water where the reading was taken)
_____ pH
_____ Dissolved oxygen
_____ Salinity
_____ Turbidity (clear, slightly turbid, turbid, opaque) Secchi disk depth_____)
_____ Other (specify)

7. Describe observed color and area of coloration. None recorded

8. If known, indicate the source of the water in the wetland.

X Stream/River/Creek/Lake/Pond
X Flooding (Potentially)
X Groundwater
X Surface runoff

9. Is there a discharge from the site to the wetland? X Yes □ No
If yes, please describe:
The un-named drainage ditch on the site flows into a culvert that runs under U.S. Route 17 and discharges into Mill Run Creek. During storm events and periods of high flows discharge from UXO-25 could drain into Mill Run Creek and the surrounding wetlands.

10. Is there a discharge from the wetland? X Yes □ No
If yes, to what water body is discharge released?

- X Marine (Name: New River)
- X Surface stream/River (Name: Mill Run Creek)
- ❑ Lake/Pond (Name:_____)
- ❑ Groundwater
- ❑ Not sure

11. Does the area show evidence of flooding? □ Yes □ No Observations were not recorded.

If yes, indicate which of the following are present (mark all that apply):

- ❑ Standing water
- ❑ Water-saturated soils
- ❑ Water marks
- ❑ Buttressing
- ❑ Debris lines
- ❑ Mud cracks
- ❑ Other (Please describe)

12. If a soil sample was collected, describe the appearance of the soil in the wetland area. Circle or write in the best response. None collected

Color (blue/gray, brown, black, mottled) _____

Water content (dry, wet, saturated/unsaturated)_____

13. Mark the observed wetland area(s) on the attached site map.

III.D Sensitive Environments and Receptors

1. Do any other potentially sensitive environmental areas[2] exist adjacent to or within one-half mile of the site? If yes, list these areas and provide the source(s) of information used to identify sensitive areas. *Do not answer "no" without confirmation from the U.S. Fish and Wildlife Service and other appropriate agencies. See Table 1 for a list of contacts.*
   Yes, wetlands associated with Mill Run Creek occur east of the site.

2. Are any areas on or near (i.e., within one-half mile) the site owned or used by local tribes? If yes, describe.
   No

3. Does the site serve or potentially serve as a habitat, foraging area or refuge by rare, threatened, endangered, candidate and/or proposed species (plants or animals), or any otherwise protected species? If yes, identify species. *This information should be obtained from the U.S. Fish and Wildlife Service and other appropriate agencies. See Table 1 for a list of contacts.*
   No. A red-cockaded woodpecker (RCW) management area is located adjacent to the Verona Loop Site. However, preferred RCW habitat is not present onsite, and the closest active RCW cluster is located 1.25 miles southeast of the site.

4. Is the site potentially used as a breeding, roosting or feeding area by migratory bird species? If yes, identify which species.
   Unknown

5. Is the site used by any ecologically[3], recreationally or commercially important species? If yes, explain.
   No

[3] Areas that provide unique and often protected habitat for wildlife species. These areas are typically used during critical life stages such as breeding, hatching, rearing of young and overwintering. Refer to Table 2 at the end of this document for examples of sensitive environments.

[3] Ecologically important species include populations of species which provide a critical (i.e., not replaceable) food resource for higher organisms. These species' functions would not be replaced by more tolerant species or perform a critical ecological function (such as organic matter decomposition) and will not be replaced by other species. Ecologically important species include pest and opportunistic species that populate an area if they serve as a food source for other species, but do not include domesticated animals (e.g., pets and livestock) or plants/animals whose existence is maintained by continuous human interventions (e.g., fish hatcheries, agricultural crops, etc).

IV. EXPOSURE PATHWAY EVALUATION

1. Do existing data provide sufficient information on the nature, rate and extent of contamination at the site?

   X Yes
   ❑ No
   ❑ Uncertain

   Please provide an explanation for your answer.
   Data were collected from each medium across the site, providing representative samples for the area of concern.

2. Do existing data provide sufficient information on the nature, rate and extent of contamination in offsite affected areas?

   X Yes
   ❑ No
   ❑ Uncertain
   ❑ No offsite contamination

   Please provide an explanation for your answer.
   Data collected from within the site indicates offsite migration is not likely

3. Do existing data address potential migration pathways of contaminants at the site?

   X Yes
   ❑ No
   ❑ Uncertain

   Please provide an explanation for your answer.
   Data were collected based on potential migration pathways (i.e. overland flow, leaching, and groundwater transport).

4. Do existing data address potential migration pathways of contaminants in offsite affected areas?

   ❑ Yes
   ❑ No
   ❑ Uncertain
   X No offsite contamination

   Please provide an explanation for your answer. Concentrations of COPCs in groundwater are not expected to be high enough to cause any discernable impact to Mill Run Creek and the New River.

5. Are there visible indications of stressed habitats or receptors on or near (i.e., within one-

half mile) the site that may be the result of a chemical release? If yes, explain. Attach photographs if available.
No

6. Is the location of the contamination such that receptors might be reasonably expected to come into contact with it? For soil, this means contamination in the soil 0 to 1 foot below ground surface (bgs). If yes, explain.
Yes. Metals and explosives were detected in surface and/or subsurface soil where receptors may be exposed.

7. Are receptors located in or using habitats where chemicals exist in air, soil, sediment or surface water? If yes, explain.
Yes, snakes and birds were observed onsite during the field investigation.

8. Could chemicals reach receptors via groundwater? Can chemicals leach or dissolve to groundwater? Are chemicals mobile in groundwater? Does groundwater discharge into receptor habitats? If yes, explain.
There were not enough water level measurement data collected to confirm the direction of shallow groundwater flow at the site. If groundwater direction does flow toward Mill Run Creek, the low level concentrations will likely attenuate upon discharging to Mill Run Creek and the New River to the extent that aquatic receptors would not be at risk.

9. Could chemicals reach receptors through runoff or erosion? Answer the following questions.
Runoff into the un-named drainage ditch onsite could reach receptors in Mill Run Creek.

10. What is the approximate distance from the contaminated area to the nearest watercourse?

- X 0 feet (i.e., contamination has reached a watercourse)
- ❑ 1-10 feet
- ❑ 11-20 feet
- ❑ 21-50 feet
- ❑ 51-100 feet
- ❑ 101-200 feet
- ❑ > 200 feet
- ❑ > 500 feet
- ❑ > 1000 feet

11. What is the slope of the ground in the contaminated area?

- X 0-10%
- ❑ 10-30%
- ❑ > 30%

12. What is the approximate amount of ground and canopy vegetative cover in the contaminated area?

- ❑ < 25%

- ❑ 25-75%
- X > 75%

13. Is there visible evidence of erosion (e.g., a rill or gully) in or near the contaminated area?

- ❑ Yes
- X No
- ❑ Do not know

14. Do any structures, pavement or natural drainage features direct run-on flow (i.e., surface flows originating upstream or uphill from the area of concern) into the contaminated area?

- ❑ Yes
- ❑ No
- X Do not know

15. Could chemicals reach receptors through the dispersion of contaminants in air (e.g., volatilization, vapors, fugitive dust)? If yes, explain.

No.

16. Could chemicals reach receptors through migration of non-aqueous phase liquids (NAPLs)? Is a NAPL present at the site that might be migrating towards receptors or habitats? Could NAPL discharge contact receptors or their habitat?

No

Table G-1

Surface Soil Data used in the ERS

Site UXO-25 - Verona Loop PA/SI

MCIEAST-MCB CAMLEJ, North Carolina

	Location		VL-MW01	VL-IS02	VL-IS03		VL-IS04	VL-IS05	VL-IS06	VL-IS07	VL-IS08	VL-IS09	VL-IS10	VL-IS11	VL-IS12	VL-IS13	VL-IS14		VL-MW02	VL-IS16
	Sample ID		VL-SS01-12B	VL-SS02-12B	VL-SS03-12B	VL-SS03D-12B	VL-SS04-12B	VL-SS05-12B	VL-SS06-12B	VL-SS07-12B	VL-SS08-12B	VL-SS09-12B	VL-SS10-12B	VL-SS11-12B	VL-SS12-12B	VL-SS13-12B	VL-SS14-12B	VL-SS14D-12B	VL-SS15-12B	VL-SS16-12B
	Sample Depth (ft)		999 - 999	999 - 999	999 - 999	999 - 999	999 - 999	999 - 999	999 - 999	999 - 999	999 - 999	999 - 999	999 - 999	999 - 999	999 - 999	999 - 999	999 - 999	999 - 999	999 - 999	999 - 999
	Sample Date		4/25/2012	4/25/2012	4/25/2012	4/25/2012	4/25/2012	4/25/2012	4/25/2012	4/25/2012	4/25/2012	4/26/2012	4/25/2012	4/26/2012	4/26/2012	4/26/2012	4/26/2012	4/26/2012	4/25/2012	4/26/2012
Analyte	**Screening Level**	**UNITS**																		
SVOC (ug/kg)																				
2,4-Dinitrotoluene	1.6	ug/kg	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U
2,6-Dinitrotoluene	6100	ug/kg	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U
Nitrobenzene	4800	ug/kg	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U
EXPLOSIVE (ug/kg)																				
1,3,5-Trinitrobenzene	220000	ug/kg	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U
1,3-Dinitrobenzene	610	ug/kg	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U
2,4,6-Trinitrotoluene	3600	ug/kg	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U
2-Amino-4,6-dinitrotoluene	15000	ug/kg	400 U	400 U	400 U	400 U	400 U	400 U	400 U	400 U	400 U	400 U	400 U	400 U	400 U	400 U	400 U	400 U	400 U	400 U
2-Nitrotoluene	2900	ug/kg	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U
3-Nitrotoluene	610	ug/kg	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U
4-Amino-2,6-dinitrotoluene	15000	ug/kg	400 U	400 U	400 U	400 U	400 U	400 U	400 U	400 U	400 U	400 U	400 U	400 U	400 U	400 U	400 U	400 U	400 U	400 U
4-Nitrotoluene	24000	ug/kg	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U
HMX	380000	ug/kg	400 U	400 U	400 U	400 U	400 U	400 U	400 U	400 U	400 U	400 U	400 U	400 U	400 U	400 U	400 U	400 U	400 U	400 U
Nitroglycerin	610	ug/kg	2500 U	2500 U	2500 U	2500 U	2500 U	2500 U	2500 U	2500 U	2500 U	2500 U	2500 U	2500 U	2500 U	2500 U	2500 U	2500 U	2500 U	2500 U
Perchlorate	5500	ug/kg	1.1 U	1.3 U	1.5 U	1.4 U	1.2 U	**0.84 J**	1.3 U	1.2 U	1.6 U	1.3 U	1.2 U	1.3 U	1.4 U	1.2 U	1.5 U	1.5 U	1.2 U	1.5 U
PETN	12000	ug/kg	1000 U	1000 U	1000 U	1000 U	1000 U	1000 U	1000 U	1000 U	1000 U	1000 U	1000 U	1000 U	1000 U	1000 U	1000 U	1000 U	1000 U	1000 U
RDX	5600	ug/kg	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U
Tetryl	24000	ug/kg	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U
METAL (mg/kg)																				
Aluminum	7700	mg/kg	**750**	**3300**	**6900**	**7300**	**4900**	**2500**	**6300**	**3600**	**15000**	**7600**	**1100**	**6400**	**16000**	**7500**	**18000**	**15000**	**1500**	**9700**
Antimony	0.9	mg/kg	**0.053 J**	**0.081 J**	**0.32**	**0.092 J**	**0.053 J**	**0.11 J**	**0.044 J**	**0.025 J**	**0.33**	**0.059 J**	0.05 U	0.05 U	**0.052 J**	**0.047 J**	**0.13 J**	**0.11 J**	**0.054 J**	**0.054 J**
Arsenic	0.39	mg/kg	**0.28 J**	**0.68**	**1**	**1.1**	**0.63**	**0.49 J**	**0.69**	**0.57**	**6.9**	**1.2**	**0.34 J**	**0.75**	**2.2**	**1.6**	**2.1**	**1.9**	**0.47 J**	**0.93**
Barium	36.7	mg/kg	**2.4**	**7.5**	**16**	**15**	**5.2**	**5.4**	**12**	**7.2**	**36**	**15**	**4.2**	**8.8**	**20**	**5.6**	**31**	**27**	**6**	**12**
Beryllium	0.195	mg/kg	0.05 U	**0.053 J**	**0.055 J**	**0.13**	**0.025 J**	**0.03 J**	**0.058 J**	**0.034 J**	**0.37**	**0.13**	0.046 U	**0.11**	**0.3**	**0.033 J**	**0.3**	**0.32**	**0.025 J**	**0.12**
Cadmium	0.2	mg/kg	**0.016 J**	**0.01 J**	**0.03 J**	**0.058**	**0.0079 J**	**0.041 J**	**0.02 J**	**0.01 J**	**0.15**	**0.033 J**	**0.013 J**	**0.0043 J**	**0.018 J**	**0.0059 J**	**0.058**	**0.055**	**0.0097 J**	**0.016 J**
Calcium	8470	mg/kg	**97**	**72**	**450**	**430**	**68**	**120**	**220**	**76**	**4200**	**720**	**89**	50 U	**110**	50 U	**720**	**570**	**190**	**110**
Chromium (hexavalent)	0.29	mg/kg	0.22 UJ	**1.92 J-**	0.29 UJ	0.26 UJ	**0.31 J-**	0.23 UJ	0.27 UJ	**0.29 J-**	0.3 UJ	0.25 UJ	0.23 UJ	**0.5 J-**	**0.41 J-**	**0.58 J-**	**0.26 J-**	**0.28 J-**	0.24 UJ	**0.97 J-**
Chromium	0.29	mg/kg	**0.81 J**	**3.8 J**	**5 J**	**6.3 J**	**3.9 J**	**2.2 J**	**5.2 J**	**2.8 J**	**16 J**	**5.6 J**	**0.96 J**	**5.5 J**	**12 J**	**6.5 J**	**12 J**	**12 J**	**1.9 J**	**6.4 J**
Cobalt	0.414	mg/kg	**0.032 J**	**0.21**	**0.21 J**	**0.29 J**	**0.13**	**0.073 J**	**0.2**	**0.13**	**1.6**	**0.32**	**0.046 J**	**0.17**	**0.56**	**0.36**	**0.73**	**0.62**	**0.056 J**	**0.28**
Copper	17.1	mg/kg	**0.38**	**0.63**	**1.1**	**1.4**	**0.33**	**2.6**	**1**	**0.51**	**6.7**	**1.2**	**0.41**	**0.31**	**0.77**	**1.8**	**2.4**	**1.9**	**0.34**	**0.46**
Iron	150	mg/kg	**570**	**1000**	**3600**	**3600**	**3200**	**1500**	**2500**	**2000**	**9000**	**3000**	**880**	**1600**	**4300**	**3600**	**4700**	**3700**	**740**	**2200**
Lead	27.5	mg/kg	**4.7**	**9.8**	**38**	**12**	**6.3**	**5.8**	**7.1**	**5.6**	**42**	**10**	**2.8**	**6.5**	**12**	**9**	**56**	**46**	**7**	**11**
Magnesium	904	mg/kg	**32 J**	**60**	**140**	**130**	**110**	**49 J**	**130**	**75**	**420**	**180**	**32 J**	**140**	**370**	**170**	**380**	**310**	**59**	**240**
Manganese	37	mg/kg	**3**	**1.9**	**5.8 J**	**14 J**	**3.9**	**2.3**	**4**	**6.2**	**79**	**4.3**	**3.3**	**2.9**	**4.7**	**3.3**	**4.7**	**4.3**	**2.6**	**3.7**
Mercury	0.161	mg/kg	**0.009 J**	**0.024 J**	**0.027 J**	**0.057**	**0.021 J**	**0.018 J**	**0.021 J**	**0.019 J**	**0.054**	**0.032 J**	**0.014 J**	**0.017 J**	**0.055**	**0.016 J**	**0.075**	**0.063**	**0.014 J**	**0.031 J**
Nickel	3.11	mg/kg	**1.3 J**	**3.5 J**	**5.9 J**	**8.3 J**	**3.1 J**	**3.1 J**	**3.9 J**	**3 J**	**4.6 J**	**2.6 J**	**2.4 J**	**0.74 J**	**2.8 J**	**1.9 J**	**3.6 J**	**4.9 J**	**0.85 J**	**4.3 J**
Potassium	359	mg/kg	**41 J**	**91**	**140**	**130**	**88**	**41 J**	**130**	**83**	**470**	**210**	**58**	**180**	**440**	**170**	**420**	**350**	**68**	**310**
Selenium	1.59	mg/kg	**0.11 J**	**0.37 J**	**0.52**	**0.55**	**0.21 J**	**0.24 J**	**0.4 J**	**0.15 J**	**1.2**	**0.53**	**0.14 J**	**0.34 J**	**1.2**	**0.24 J**	**0.75**	**0.74**	**0.23 J**	**0.47 J**
Silver	0.354	mg/kg	0.01 U	**0.0044 J**	**0.006 J**	**0.0078 J**	0.01 U	0.01 U	**0.007 J**	0.01 U	**0.021 J**	**0.0087 J**	0.0093 U	0.01 U	**0.0088 J**	**0.0046 J**	**0.017 J**	**0.018 J**	0.01 U	**0.007 J**
Sodium	250	mg/kg	25 U	23 U	25 U	25 U	23 U	25 U	25 U	25 U	**95**	**22 J**	25 U	**8.3 J**	**22 J**	**6.7 J**	**34 J**	**28 J**	25 U	**21 J**
Thallium	0.078	mg/kg	**0.01 J**	**0.021 J**	**0.05 J**	**0.087 J**	**0.029 J**	**0.033 J**	**0.043 J**	**0.037 J**	**0.13**	**0.053 J**	**0.015 J**	**0.043 J**	**0.13**	**0.046 J**	**0.11**	**0.1**	**0.011 J**	**0.063 J**
Vanadium	6	mg/kg	**2.5 J**	**4.2 J**	**7.4 J**	**9.1 J**	**7.3 J**	**3.1 J**	**7 J**	**5.3 J**	**29 J**	**9.7 J**	**2.8 J**	**8 J**	**19 J**	**12 J**	**16 J**	**14 J**	**2.7 J**	**8.3 J**
Zinc	28.6	mg/kg	**2.1**	**2.4**	**5.1 J**	**10 J**	**2.5**	**2.6**	**3.4**	**2.3**	**120**	**7.4**	**1.6 J**	**1.3 J**	**6.3**	**5.4**	**11**	**9.2**	**1.4 J**	**4.5**

Table G-1

Surface Soil Data used in the ERS

Site UXO-25 - Verona Loop PA/SI

MCIEAST-MCB CAMLEJ, North Carolina

	Location		VL-MW01	VL-IS02	VL-IS03		VL-IS04	VL-IS05	VL-IS06	VL-IS07	VL-IS08	VL-IS09	VL-IS10	VL-IS11	VL-IS12	VL-IS13	VL-IS14		VL-MW02	VL-IS16
	Sample ID		VL-SS01-12B	VL-SS02-12B	VL-SS03-12B	VL-SS03D-12B	VL-SS04-12B	VL-SS05-12B	VL-SS06-12B	VL-SS07-12B	VL-SS08-12B	VL-SS09-12B	VL-SS10-12B	VL-SS11-12B	VL-SS12-12B	VL-SS13-12B	VL-SS14-12B	VL-SS14D-12B	VL-SS15-12B	VL-SS16-12B
	Sample Depth (ft)		999 - 999	999 - 999	999 - 999	999 - 999	999 - 999	999 - 999	999 - 999	999 - 999	999 - 999	999 - 999	999 - 999	999 - 999	999 - 999	999 - 999	999 - 999	999 - 999	999 - 999	999 - 999
	Sample Date		4/25/2012	4/25/2012	4/25/2012	4/25/2012	4/25/2012	4/25/2012	4/25/2012	4/25/2012	4/25/2012	4/26/2012	4/25/2012	4/26/2012	4/26/2012	4/26/2012	4/26/2012	4/26/2012	4/25/2012	4/26/2012
Analyte	**Screening Level**	**UNITS**																		

Notes:

NA = Not analyzed

J = The analyte was positively identified: the associated numerical value is the approximate concentration of the analyte in the sample.

mg/kg = miligram per kilogram

SVOC = semivolatile organic compound

U = The analyte was analyzed for, but was not detected above the reported sample quantitation limit.

ug/kg = micrograms per kilogram

UJ = The analyte was below the reported sample quantitation limit. However, the reported value is approximate.

Bold indicates the analyte was detected

Shading indicates the result exceeded screening criteria

Table G-2

Subsurface Soil Data used in the ERS

Site UXO-25 - Verona Loop PA/SI

MCIEAST-MCB CAMLEJ, North Carolina

	Location		VL-MW01	VL-IS02	VL-IS03		VL-IS04	VL-IS05	VL-IS06	VL-IS07	VL-IS08	VL-IS09	VL-IS10	VL-IS11	VL-IS12	VL-IS13	VL-IS14		VL-MW02	VL-IS16
	Sample ID		VL-SB01-1-6-12B	VL-SB02-1-5-12B	VL-SB03-1-5-12B	VL-SB03D-1-5-12B	VL-SB04-1-5-12B	VL-SB05-1-5-12B	VL-SB06-1-5-12B	VL-SB07-1-4-12B	VL-SB08-1-4-12B	VL-SB09-1-4-12B	VL-SB10-1-4-12B	VL-SB11-1-4-12B	VL-SB12-1-4-12B	VL-SB13-1-4-12B	VL-SB14-1-4-12B	VL-SB14D-1-4-12B	VL-SB15-1-6_5-12B	VL-SB16-1-5-12B
	Sample Depth (ft)		1 - 6	1 - 5	1 - 5	1 - 5	1 - 5	1 - 5	1 - 5	1 - 4	1 - 4	1 - 4	1 - 4	1 - 4	1 - 4	1 - 4	1 - 4	1 - 4	1 - 6.5	1 - 5
	Sample Date		4/24/2012	4/25/2012	4/25/2012	4/25/2012	4/25/2012	4/25/2012	4/25/2012	4/25/2012	4/25/2012	4/26/2012	4/25/2012	4/26/2012	4/26/2012	4/26/2012	4/26/2012	4/26/2012	4/24/2012	4/26/2012
Analyte	**Screening Level**	**UNITS**																		
SVOC (ug/kg)																				
2,4-Dinitrotoluene	1.6	ug/kg	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U
2,6-Dinitrotoluene	6100	ug/kg	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U
Nitrobenzene	4800	ug/kg	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U
EXPLOSIVES (ug/kg)																				
1,3,5-Trinitrobenzene	220000	ug/kg	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U
1,3-Dinitrobenzene	610	ug/kg	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U
2,4,6-Trinitrotoluene	3600	ug/kg	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U
2-Amino-4,6-dinitrotoluene	15000	ug/kg	400 U	400 U	400 U	400 U	400 U	400 U	400 U	400 U	400 U	400 U	400 U	400 U	400 U	400 U	400 U	400 U	400 U	400 U
2-Nitrotoluene	2900	ug/kg	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U
3-Nitrotoluene	610	ug/kg	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U
4-Amino-2,6-dinitrotoluene	15000	ug/kg	400 U	400 U	400 U	400 U	400 U	400 U	400 U	400 U	400 U	400 U	400 U	400 U	400 U	400 U	400 U	400 U	400 U	400 U
4-Nitrotoluene	24000	ug/kg	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U
HMX	380000	ug/kg	400 U	400 U	400 U	400 U	400 U	400 U	400 U	400 U	400 U	400 U	400 U	400 U	400 U	400 U	400 U	400 U	400 U	400 U
Nitroglycerin	610	ug/kg	2500 U	2500 U	2500 U	2500 U	2500 U	2500 U	2500 U	2500 U	2500 U	2300 U	2500 U	2500 U	2500 U	2500 U	2500 U	2500 U	2500 U	2500 U
Perchlorate	5500	ug/kg	1.2 U	1.3 U	1.2 U	1.2 U	1.2 U	1.2 U	1.2 U	1.2 U	1.4 U	1.3 U	1.2 U	1.5 U	1.4 U	1.3 U	1.5 U	1.4 U	1.2 U	1.3 U
PETN	12000	ug/kg	1000 U	1000 U	1000 U	1000 U	1000 U	1000 U	1000 U	1000 U	1000 U	910 U	1000 U	1000 U	1000 U	1000 U	1000 U	1000 U	1000 U	1000 U
RDX	5600	ug/kg	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U
Tetryl	24000	ug/kg	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U
METAL (mg/kg)																				
Aluminum	7700	mg/kg	**4100**	**10000**	**13000**	**14000**	**7100**	**8000**	**10000**	**11000**	**13000**	**8000**	**13000**	**13000**	**18000**	**8500**	**15000 J**	**11000 J**	**5200**	**11000**
Antimony	0.9	mg/kg	0.05 U	0.046 U	**0.054 J**	**0.05 J**	**0.055 J**	**0.069 J**	**0.033 J**	**0.033 J**	**0.17 J**	0.05 U	**0.068 J**	**0.054 J**	**0.032 J**	**0.033 J**	0.05 U	0.05 U	0.047 U	**0.029 J**
Arsenic	0.39	mg/kg	**0.57**	**0.62**	**1.3**	**1.4**	**1.2**	**1.3**	**0.72**	**1.6**	**3**	**1.1**	**2.3**	**1.4**	**2.9**	**1.5**	**0.98 J**	**1.4 J**	**0.45 J**	**1.2**
Barium	28.3	mg/kg	**2.1 J**	**10 J**	**14 J**	**15 J**	**6.1 J**	**4.8 J**	**13 J**	**26 J**	**23 J**	**9.3 J**	**7.5 J**	**12 J**	**20 J**	**6.8 J**	**18 J**	**15 J**	**9.5 J**	**12 J**
Beryllium	0.332	mg/kg	**0.022 J**	**0.083 J**	**0.089 J**	**0.071 J**	**0.032 J**	**0.023 J**	**0.071 J**	**0.14**	**0.22**	**0.082 J**	**0.046 J**	**0.1**	**0.22**	**0.036 J**	**0.11**	**0.14**	**0.13**	**0.1**
Cadmium	0.208	mg/kg	0.046 U	**0.02 J**	**0.0052 J**	0.05 U	**0.0041 J**	**0.0096 J**	0.05 U	**0.0039 J**	**0.069**	**0.0086 J**	0.05 U	**0.0057 J**	**0.0074 J**	0.05 U	**0.0051 J**	**0.0056 J**	**0.01 J**	**0.0061 J**
Calcium	1530	mg/kg	50 U	50 U	50 U	50 U	50 U	46 U	50 U	**64**	**3000**	**190**	50 U	50 U	**110**	**21 J**	**140**	**130**	**72**	**31 J**
Chromium (hexavalent)	0.29	mg/kg	**3.71 J-**	**3.25 J-**	**4.27 J-**	**4.45 J-**	**4.77 J-**	**5.97 J-**	**4.28 J-**	**3.8 J-**	0.27 UJ	**1.36 J-**	**5.05 J-**	**6.59 J-**	**2.43 J-**	**3.78 J-**	**3.31 J-**	**3.3 J-**	**3.9 J-**	**4.55 J-**
Chromium	0.29	mg/kg	**4.6**	**7.5**	**9.5**	**10**	**6.6**	**8.6**	**9.4**	**10**	**10**	**5.9**	**10**	**9.5**	**11**	**7.7**	**9.3**	**9.3**	**5.3**	**8.6**
Cobalt	0.9	mg/kg	**0.26**	**0.32**	**0.5**	**0.54**	**0.24**	**0.25**	**0.43**	**0.49**	**0.73**	**0.25**	**0.46**	**0.37**	**0.53**	**0.36**	**0.38**	**0.31**	**0.14**	**0.3**
Copper	6.05	mg/kg	**0.52**	**0.16 J**	**0.48**	**0.55**	**0.41**	**0.57**	**0.34**	**1.3**	**3.3**	**0.6**	**1.2**	**0.26**	**0.44**	**1.2**	**0.27**	**0.24**	**0.48**	**0.22**
Iron	150	mg/kg	**1700**	**1200**	**4400**	**4100**	**4300**	**4900**	**4100**	**6900**	**7500**	**3300**	**9300**	**10000**	**4400**	**2700**	**2400**	**2000**	**1000**	**3600**
Lead	11.2	mg/kg	**2.4**	**5.2**	**5.8**	**6.2**	**4**	**3.1**	**5**	**5.9**	**18**	**5.9**	**4.4**	**4.9**	**7.9**	**5.1**	**6.7**	**6.8**	**4.1**	**5.8**
Magnesium	776	mg/kg	**68**	**240**	**360**	**360**	**170**	**110**	**300**	**340**	**340**	**170**	**270**	**320**	**450**	**200**	**410 J**	**270 J**	**150**	**280**
Manganese	18.3	mg/kg	**1.7**	**2.9**	**5**	**4.9**	**3.1**	**2.6**	**5**	**6.9**	**31**	**3.2**	**3.8**	**3.7**	**4.5**	**3.4**	**4.2**	**3.4**	**3.8**	**3.9**
Mercury	0.0852	mg/kg	0.017 U	**0.017 J**	**0.008 J**	**0.012 J**	**0.0098 J**	**0.014 J**	**0.011 J**	**0.017 J**	**0.033 J**	**0.02 J**	**0.013 J**	**0.014 J**	**0.036 J**	**0.016 J**	**0.024 J**	**0.025 J**	0.017 U	**0.017 J**
Nickel	7.08	mg/kg	**1.2**	**1.3**	**2.1**	**2.2**	**1**	**1.2**	**1.7**	**2**	**2.7**	**1.3**	**2**	**1.5**	**2.9**	**1.7**	**1.6**	**1.3**	**0.57**	**1.1**
Potassium	620	mg/kg	**79**	**230**	**250**	**260**	**170**	**110**	**220**	**260**	**410**	**200**	**270**	**330**	**540**	**230**	**410**	**320**	**300**	**320**
Selenium	0.736	mg/kg	**0.12 J**	**0.28 J**	**0.21 J**	**0.31 J**	**0.31 J**	**0.29 J**	**0.18 J**	**0.27 J**	**0.74**	**0.34 J**	**0.39 J**	**0.29 J**	**0.55**	**0.2 J**	**0.34 J**	**0.51**	**0.16 J**	**0.38 J**
Silver	0.198	mg/kg	0.0092 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.0094 U	**0.011 J**	**0.0047 J**	0.01 U	**0.0047 J**	**0.0047 J**	0.01 U	**0.0083 J**	**0.0077 J**	**0.0058 J**	**0.0053 J**
Sodium	--	--	25 U	25 U	25 U	25 U	25 U	23 U	25 U	23 U	**93**	**19 J**	25 U	**17 J**	**25 J**	**6.6 J**	**22 J**	**18 J**	25 U	**18 J**
Thallium	0.078	mg/kg	**0.015 J**	**0.095 J**	**0.1**	**0.11**	**0.045 J**	**0.045 J**	**0.091 J**	**0.1**	**0.091 J**	**0.052 J**	**0.065 J**	**0.083 J**	**0.12**	**0.058 J**	**0.12**	**0.11**	**0.051 J**	**0.085 J**
Vanadium	6	mg/kg	**4.9**	**7.6**	**14**	**15**	**10**	**11**	**11**	**17**	**18**	**11**	**19**	**19**	**25**	**15**	**11**	**9**	**7.5**	**12**
Zinc	14.1	mg/kg		**3**	**4.7**	**5.8**	**2.5**	**5**	**3.9**	**4.3**	**44**	**4**	**2.8**	**2.3**	**5.4**	**6.4**	**4.9 J**	**3.3 J**	**2.1**	**3.2**

Notes:

NA = Not analyzed

J = The analyte was positively identified: the associated numerical value is the approximate concentration of the analyte in the sample.

mg/kg = miligram per kilogram

SVOC = semivolatile organic compound

U = The analyte was analyzed for, but was not detected above the reported sample quantitation limit.

ug/kg = micrograms per kilogram

UJ = The analyte was below the reported sample quantitation limit. However, the reported value is approximate.

Bold indicates the analyte was detected

Shading indicates the result exceeded screening criteria

Table G-3

Groundwater Data used in the ERS

Site UXO-25 - Verona Loop PA/SI

MCIEAST-MCB CAMLEJ, North Carolina

Analyte	Location	VL-MW01	VL-MW02	
	Sample ID	VL-GW01-12B	VL-GW02-12B	VL-GW02D-12B
	Sample Depth (ft)	999 - 999	999 - 999	999 - 999
	Sample Date	4/26/2012	4/26/2012	4/26/2012
	Screening Level			
SVOC (ug/L)				
2,4-Dinitrotoluene	0.1	0.52 U	0.52 U	0.52 U
2,6-Dinitrotoluene	--	0.52 U	0.52 U	0.52 U
Nitrobenzene	--	0.52 U	0.52 U	0.52 U
EXPLOSIVES (ug/L)				
1,3,5-Trinitrobenzene	--	0.52 U	0.52 U	0.52 U
1,3-Dinitrobenzene	--	0.52 U	0.52 U	0.52 U
2,4,6-Trinitrotoluene	--	0.52 U	0.52 U	0.52 U
2-Amino-4,6-dinitrotoluene	--	1 U	1 U	1 U
2-Nitrotoluene	--	0.52 U	0.52 U	0.52 U
3-Nitrotoluene	--	0.52 U	0.52 U	0.52 U
4-Amino-2,6-dinitrotoluene	--	0.52 U	0.52 U	0.52 U
4-Nitrotoluene	--	0.52 U	0.52 U	0.52 U
HMX	--	0.52 UJ	0.52 UJ	0.52 UJ
Nitroglycerin	--	0.65 U	0.65 U	0.65 U
Perchlorate	2	0.1 U	0.1 U	0.1 U
PETN	--	0.65 U	0.65 U	0.65 U
RDX	--	0.52 U	0.52 U	0.52 U
Tetryl	--	0.52 U	0.52 U	0.52 U
METAL (ug/L)				
Aluminum	--	**130**	**150**	**89 J**
Antimony	1	0.5 U	0.5 U	0.5 U
Arsenic	10	**0.26 J**	0.5 U	0.5 U
Barium	700	**19**	**43**	**40**
Beryllium	4	0.4 U	**0.12 J**	0.4 U
Cadmium	2	**0.051 J**	0.1 U	0.1 U
Calcium	--	**3400**	**2300**	**2100**
Chromium (hexavalent)	10	10 U	10 U	10 U
Chromium	10	**0.22 J**	**0.47 J**	**0.24 J**
Cobalt	1	**0.56 J**	**1.3**	**1.2**
Copper	1000	**0.25 J**	**0.38 J**	**0.25 J**
Iron	300	**680**	**1100**	**980**
Lead	15	**0.19 J**	**0.16 J**	**0.17 J**
Magnesium	--	**780**	**610**	**570**
Manganese	50	**18**	**42**	**39**
Mercury	1	0.1 U	**0.46**	0.1 U
Nickel	100	**0.99 J**	**2.6**	**2.3**
Potassium	--	**500**	**1300**	**1300**
Selenium	20	1 U	1 U	**0.63 J**
Silver	20	0.1 U	0.1 U	0.1 U
METAL (ug/L) (CONTINUED)				

Table G-3

Groundwater Data used in the ERS

Site UXO-25 - Verona Loop PA/SI

MCIEAST-MCB CAMLEJ, North Carolina

Analyte	Location	VL-MW01	VL-MW02	
	Sample ID	VL-GW01-12B	VL-GW02-12B	VL-GW02D-12B
	Sample Depth (ft)	999 - 999	999 - 999	999 - 999
	Sample Date	4/26/2012	4/26/2012	4/26/2012
	Screening Level			
Sodium	--	**5000**	**9300**	**8800**
Thallium	0.2	0.1 U	0.1 U	0.1 U
Vanadium	0.3	**0.4 J**	**0.33 J**	**0.29 J**
Zinc	1000	**10**	**20 J**	**35 J**
FILTERED METALS (ug/L)				
Aluminum, Dissolved	--	**31 J**	50 U	50 U
Antimony, Dissolved	1	0.5 U	0.5 U	0.5 U
Arsenic, Dissolved	10	0.5 U	**0.25 J**	0.5 U
Barium, Dissolved	700	**20**	**36**	**32**
Beryllium, Dissolved	4	0.4 U	0.4 U	**0.12 J**
Cadmium, Dissolved	2	0.1 U	0.1 U	0.1 U
Calcium, Dissolved	--	**3500**	**2000**	**2000**
Chromium, Dissolved	10	**0.21 J**	0.5 U	0.5 U
Cobalt, Dissolved	1	**0.6 J**	**0.98 J**	**1**
Copper, Dissolved	1000	0.5 U	**0.34 J**	**0.79 J**
Iron, Dissolved	300	**630**	**1100**	**1100**
Lead, Dissolved	15	0.5 U	0.5 U	0.5 U
Magnesium, Dissolved	--	**810**	**560**	**590**
Manganese, Dissolved	50	**20**	**32**	**33**
Mercury, Dissolved	1	0.1 U	**0.19 J**	0.1 U
Nickel, Dissolved	100	**0.96 J**	**2**	**2.1**
Potassium, Dissolved	--	**530**	**1200**	**1300**
Selenium, Dissolved	20	**1.3 J**	1 U	**1.4 J**
Silver, Dissolved	20	0.1 U	0.1 U	0.1 U
Sodium, Dissolved	--	**5100**	**8800**	**9100**
Thallium, Dissolved	0.2	0.1 U	0.1 U	0.1 U
Vanadium, Dissolved	0.3	**0.38 J**	**0.15 J**	**0.14 J**
Zinc, Dissolved	1000	**12 J**	**22 J**	**14 J**

Notes:

NA = Not analyzed

J = The analyte was positively identified: the associated numerical value is the approximate concentration of the analyte in the sample.

SVOC = semivolatile organic compound

U = The analyte was analyzed for, but was not detected above the reported sample quantitation limit.

ug/L = microgram per liter

UJ = The analyte was below the reported sample quantitation limit. However, the reported value is approximate.

Bold indicates the analyte was detected

Shading indicates the result exceeded screening criteria

TABLE G-4

Surface Soil Screen

Site UXO-25 - Verona Loop PA/SI

MCIEAST-MCB CAMLEJ, North Carolina

Chemical	Range of Non-Detect Values	Frequency of Detection	Maximum Concentration Detected	Sample ID of Maximum Detected Concentration	Screening Value	Frequency of Exceedance[1]	Maximum Hazard Quotient	Arithmetic Mean	Mean Hazard Quotient	Supplemental Screening Value	Supplemental Screening Value Source	Supplemental Screening Value Maximum HQ	Base Background Value[3]	Retain?	Rationale?
Explosives (UG/KG)															
1,3,5-Trinitrobenzene	200 - 200	0 / 16	--	--	NSV	-- / --	NSV	100	NSV	--	--	--	--	No	Not detected
1,3-Dinitrobenzene	200 - 200	0 / 16	--	--	NSV	-- / --	NSV	100	NSV	--	--	--	--	No	Not detected
2,4,6-Trinitrotoluene	200 - 200	0 / 16	--	--	NSV	-- / --	NSV	100	NSV	--	--	--	--	No	Not detected
2,4-Dinitrotoluene	200 - 200	0 / 16	--	--	NSV	-- / --	NSV	100	NSV	--	--	--	--	No	Not detected
2,6-Dinitrotoluene	200 - 200	0 / 16	--	--	NSV	-- / --	NSV	100	NSV	--	--	--	--	No	Not detected
2-Amino-4,6-dinitrotoluen	400 - 400	0 / 16	--	--	NSV	-- / --	NSV	200	NSV	--	--	--	--	No	Not detected
2-Nitrotoluene	200 - 200	0 / 16	--	--	NSV	-- / --	NSV	100	NSV	--	--	--	--	No	Not detected
3-Nitrotoluene	200 - 200	0 / 16	--	--	NSV	-- / --	NSV	100	NSV	--	--	--	--	No	Not detected
4-Amino-2,6-dinitrotoluen	400 - 400	0 / 16	--	--	NSV	-- / --	NSV	200	NSV	--	--	--	--	No	Not detected
4-Nitrotoluene	200 - 200	0 / 16	--	--	NSV	-- / --	NSV	100	NSV	--	--	--	--	No	Not detected
HMX	400 - 400	0 / 16	--	--	NSV	-- / --	NSV	200	NSV	--	--	--	--	No	Not detected
Nitrobenzene	200 - 200	0 / 16	--	--	40,000	-- / --	0.0050	100	0.0025	--	--	--	--	No	Not detected, HQ less than one
Nitroglycerin	2,500 - 2,500	0 / 16	--	--	NSV	-- / --	NSV	1,250	NSV	--	--	--	--	No	Not detected
Perchlorate	1.10 - 1.60	1 / 16	0.84	VL-SS05-12B	NSV	-- / --	NSV	0.67	NSV	1,000	EPA, 2002	0.00084	--	No	Supplemental HQ less than one
PETN	1,000 - 1,000	0 / 16	--	--	NSV	-- / --	NSV	500	NSV	--	--	--	--	No	Not detected
RDX	200 - 200	0 / 16	--	--	NSV	-- / --	NSV	100	NSV	--	--	--	--	No	Not detected
Tetryl	200 - 200	0 / 16	--	--	NSV	-- / --	NSV	100	NSV	--	--	--	--	No	Not detected
Inorganics (MG/KG)															
Aluminum	-- - --	16 / 16	18,000	VL-SS14-12B	50.0	16 / 16	360	6,966	139	--	--	--	12800	No	Only 1 of 16 samples exceeded BTV
Antimony	0.050 - 0.050	14 / 16	0.33	VL-SS08-12B	0.27	2 / 16	1.22	0.091	0.34	--	--	--	1.87	No	Consistent with background
Arsenic	-- - --	16 / 16	6.90	VL-SS08-12B	18.0	0 / 16	0.38	1.31	0.073	--	--	--	1.17	No	HQs less than one
Barium	-- - --	16 / 16	36.0	VL-SS08-12B	330	0 / 16	0.11	12.1	0.037	--	--	--	36.7	No	HQs less than one
Beryllium	0.046 - 0.050	14 / 16	0.37	VL-SS08-12B	21.0	0 / 16	0.018	0.11	0.0053	--	--	--	0.195	No	HQs less than one
Cadmium	-- - --	16 / 16	0.15	VL-SS08-12B	0.36	0 / 16	0.42	0.029	0.082	--	--	--	0.2	No	HQs less than one
Calcium [2]	50.0 - 50.0	14 / 16	4,200	VL-SS08-12B	NSV	-- / --	NSV	456	NSV	--	--	--	8470	No	Macronutrient
Chromium (hexavalent)	0.22 - 0.30	8 / 16	1.92	VL-SS02-12B	NSV	-- / --	NSV	0.39	NSV	130	EPA, 2008	0.015	2.73	No	Supplemental HQ less than one, consistent with background
Chromium	-- - --	16 / 16	16.0	VL-SS08-12B	26.0	0 / 16	0.62	5.74	0.22	--	--	--	17.4	No	HQs less than one
Cobalt	-- - --	16 / 16	1.60	VL-SS08-12B	13.0	0 / 16	0.12	0.32	0.025	--	--	--	0.414	No	HQs less than one
Copper	-- - --	16 / 16	6.70	VL-SS08-12B	28.0	0 / 16	0.24	1.33	0.047	--	--	--	17.1	No	HQs less than one
Iron	-- - --	16 / 16	9,000	VL-SS08-12B	200	16 / 16	45.0	2,774	13.9	--	--	--	7210	No	Only 1 of 16 samples exceeded BTV
Lead	-- - --	16 / 16	56.0	VL-SS14-12B	11.0	5 / 16	5.09	14.6	1.33	--	--	--	27.5	No	Mean HQ has low magnitude of exceedance
Magnesium [2]	-- - --	16 / 16	420	VL-SS08-12B	NSV	-- / --	NSV	162	NSV	--	--	--	904	No	Macronutrient
Manganese	-- - --	16 / 16	79.0	VL-SS08-12B	220	0 / 16	0.36	8.99	0.041	--	--	--	37	No	HQs less than one
Mercury	-- - --	16 / 16	0.075	VL-SS14-12B	0.10	0 / 16	0.75	0.030	0.30	--	--	--	0.161	No	HQs less than one
Nickel	-- - --	16 / 16	8.30	VL-SS03-12B	38.0	0 / 16	0.22	3.21	0.084	--	--	--	3.11	No	HQs less than one
Potassium [2]	-- - --	16 / 16	470	VL-SS08-12B	NSV	-- / --	NSV	184	NSV	--	--	--	359	No	Macronutrient
Selenium	-- - --	16 / 16	1.20	VL-SS08-12B	0.52	5 / 16	2.31	0.45	0.86	--	--	--	1.59	No	Consistent with background
Silver	0.0093 - 0.010	9 / 16	0.021	VL-SS08-12B	4.20	0 / 16	0.0050	0.0076	0.0018	--	--	--	0.354	No	HQs less than one
Sodium [2]	23.0 - 25.0	7 / 16	95.0	VL-SS08-12B	NSV	-- / --	NSV	20.0	NSV	--	--	--	250	No	Macronutrient
Thallium	-- - --	16 / 16	0.13	VL-SS08-12B	1.00	0 / 16	0.13	0.054	0.054	--	--	--	--	No	HQs less than one
Vanadium	-- - --	16 / 16	29.0	VL-SS08-12B	7.80	8 / 16	3.72	9.13	1.17	--	--	--	17.6	No	Mean HQ has low magnitude of exceedance
Zinc	-- - --	16 / 16	120	VL-SS08-12B	46.0	1 / 16	2.61	11.5	0.25	--	--	--	28.6	No	Mean HQ is less than one and only one detections exceeds the ESV.

NOTES

1 - Count of detected samples exceeding or equaling Screening Value

2 - Macronutrient - Not considered to be a COPC

3 - Background threshold value, surface soil for undeveloped areas (combined soil types)

HQ - Hazard Quotient

NSV - No Screening Value

MG/KG - Milligrams per kilogram

UG/KG - Micrograms per kilogram

TABLE G-5

Subsurface Soil Screen

Site UXO-25 - Verona Loop PA/SI

MCIEAST-MCB CAMLEJ, North Carolina

Chemical	Range of Non-Detect Values	Frequency of Detection	Maximum Concentration Detected	Sample ID of Maximum Detected Concentration	Screening Value	Frequency of Exceedance[1]	Maximum Hazard Quotient	Arithmetic Mean	Mean Hazard Quotient	Supplemental Screening Value	Supplemental Screening Value Source	Supplemental Screening Value Maximum HQ	Base Background Value[3]	Retain?	Rationale
Explosives (UG/KG)															
1,3,5-Trinitrobenzene	200 - 200	0 / 16	--	--	NSV	-- / --	NSV	100	NSV	--	--	--	--	No	Not detected
1,3-Dinitrobenzene	200 - 200	0 / 16	--	--	NSV	-- / --	NSV	100	NSV	--	--	--	--	No	Not detected
2,4,6-Trinitrotoluene	200 - 200	0 / 16	--	--	NSV	-- / --	NSV	100	NSV	--	--	--	--	No	Not detected
2,4-Dinitrotoluene	200 - 200	0 / 16	--	--	NSV	-- / --	NSV	100	NSV	--	--	--	--	No	Not detected
2,6-Dinitrotoluene	200 - 200	0 / 16	--	--	NSV	-- / --	NSV	100	NSV	--	--	--	--	No	Not detected
2-Amino-4,6-dinitrotoluen	400 - 400	0 / 16	--	--	NSV	-- / --	NSV	200	NSV	--	--	--	--	No	Not detected
2-Nitrotoluene	200 - 200	0 / 16	--	--	NSV	-- / --	NSV	100	NSV	--	--	--	--	No	Not detected
3-Nitrotoluene	200 - 200	0 / 16	--	--	NSV	-- / --	NSV	100	NSV	--	--	--	--	No	Not detected
4-Amino-2,6-dinitrotoluen	400 - 400	0 / 16	--	--	NSV	-- / --	NSV	200	NSV	--	--	--	--	No	Not detected
4-Nitrotoluene	200 - 200	0 / 16	--	--	NSV	-- / --	NSV	100	NSV	--	--	--	--	No	Not detected
HMX	400 - 400	0 / 16	--	--	NSV	-- / --	NSV	200	NSV	--	--	--	--	No	Not detected
Nitrobenzene	200 - 200	0 / 16	--	--	40,000	-- / --	0.0050	100	0.0025	--	--	--	--	No	Not detected
Nitroglycerin	2,300 - 2,500	0 / 16	--	--	NSV	-- / --	NSV	1,244	NSV	--	--	--	--	No	Not detected
Perchlorate	1.20 - 1.50	0 / 16	--	--	NSV	-- / --	NSV	0.64	NSV	--	--	--	--	No	Not detected
PETN	910 - 1,000	0 / 16	--	--	NSV	-- / --	NSV	497	NSV	--	--	--	--	No	Not detected
RDX	200 - 200	0 / 16	--	--	NSV	-- / --	NSV	100	NSV	--	--	--	--	No	Not detected
Tetryl	200 - 200	0 / 16	--	--	NSV	-- / --	NSV	100	NSV	--	--	--	--	No	Not detected
Inorganics (MG/KG)															
Aluminum	-- - --	16 / 16	18,000	VL-SB12-1-4-12B	50.0	16 / 16	360	10,556	211	--	--	--	19000	No	Consistent with background
Antimony	0.046 - 0.050	11 / 16	0.17	VL-SB08-1-4-12B	0.27	0 / 16	0.63	0.047	0.17	--	--	--	1.1	No	HQ less than one
Arsenic	-- - --	16 / 16	3.00	VL-SB08-1-4-12B	18.0	0 / 16	0.17	1.42	0.079	--	--	--	5.1	No	HQ less than one
Barium	-- - --	16 / 16	26.0	VL-SB07-1-4-12B	330	0 / 16	0.079	12.2	0.037	--	--	--	28.3	No	HQ less than one
Beryllium	-- - --	16 / 16	0.22	VL-SB08-1-4-12B	21.0	0 / 16	0.010	0.096	0.0046	--	--	--	0.33	No	HQ less than one
Cadmium	0.046 - 0.050	12 / 16	0.069	VL-SB08-1-4-12B	0.36	0 / 16	0.19	0.016	0.044	--	--	--	0.21	No	HQ less than one
Calcium [2]	46.0 - 50.0	8 / 16	3,000	VL-SB08-1-4-12B	NSV	-- / --	NSV	239	NSV	--	--	--	1530	No	Macronutrient
Chromium (hexavalent)	0.27 - 0.27	15 / 16	6.59	VL-SB11-1-4-12B	NSV	-- / --	NSV	3.83	NSV	130	EPA, 2008	0.05	3.74	No	Supplemental HQ less than one
Chromium	-- - --	16 / 16	11.0	VL-SB12-1-4-12B	26.0	0 / 16	0.42	8.38	0.32	--	--	--	27.60	No	HQ less than one
Cobalt	-- - --	16 / 16	0.73	VL-SB08-1-4-12B	13.0	0 / 16	0.056	0.38	0.029	--	--	--	1.36	No	HQ less than one
Copper	-- - --	16 / 16	3.30	VL-SB08-1-4-12B	28.0	0 / 16	0.12	0.74	0.026	--	--	--	6.1	No	HQ less than one
Iron	-- - --	16 / 16	10,000	VL-SB11-1-4-12B	200	16 / 16	50.0	4,481	22.4	--	--	--	12700	No	Consistent with background
Lead	-- - --	16 / 16	18.0	VL-SB08-1-4-12B	11.0	1 / 16	1.64	5.92	0.54	--	--	--	11.2	No	Mean HQ less than one
Magnesium [2]	-- - --	16 / 16	450	VL-SB12-1-4-12B	NSV	-- / --	NSV	261	NSV	--	--	--	776	No	Macronutrient
Manganese	-- - --	16 / 16	31.0	VL-SB08-1-4-12B	220	0 / 16	0.14	5.54	0.025	--	--	--	18.3	No	HQ less than one
Mercury	0.017 - 0.017	14 / 16	0.036	VL-SB12-1-4-12B	0.10	0 / 16	0.36	0.017	0.17	--	--	--	0.09	No	HQ less than one
Nickel	-- - --	16 / 16	2.90	VL-SB12-1-4-12B	38.0	0 / 16	0.076	1.62	0.043	--	--	--	7.1	No	HQ less than one
Potassium [2]	-- - --	16 / 16	540	VL-SB12-1-4-12B	NSV	-- / --	NSV	271	NSV	--	--	--	620	No	Macronutrient
Selenium	-- - --	16 / 16	0.74	VL-SB08-1-4-12B	0.52	2 / 16	1.42	0.33	0.64	--	--	--	0.74	No	Mean HQ less than one
Silver	0.0092 - 0.010	7 / 16	0.011	VL-SB08-1-4-12B	4.20	0 / 16	0.0026	0.0056	0.0013	--	--	--	0.20	No	HQ less than one
Sodium [2]	23.0 - 25.0	7 / 16	93.0	VL-SB08-1-4-12B	NSV	-- / --	NSV	19.4	NSV	--	--	--	--	No	Macronutrient
Thallium	-- - --	16 / 16	0.12	VL-SB12-1-4-12B	1.00	0 / 16	0.12	0.077	0.077	--	--	--	--	No	HQ less than one
Vanadium	-- - --	16 / 16	25.0	VL-SB12-1-4-12B	7.80	13 / 16	3.21	13.4	1.71	--	--	--	35.6	No	Consistent with background
Zinc	-- - --	15 / 15	44.0	VL-SB08-1-4-12B	46.0	0 / 15	0.96	6.64	0.14	--	--	--	14.1	No	HQ less than one

NOTES

1 - Count of detected samples exceeding or equaling Screening Value

2 - Macronutrient - Not considered to be a COPC

3 - Background threshold value, subsurface soil undeveloped areas (combined soil types)

HQ - Hazard Quotient

NSV - No Screening Value

MG/KG - Milligrams per kilogram

UG/KG - Micrograms per kilogram

TABLE G-6

Groundwater Screen

Site UXO-25 - Verona Loop PA/SI

MCIEAST-MCB CAMLEJ, North Carolina

Chemical	Range of Non-Detect Values	Frequency of Detection	Maximum Concentration Detected	Sample ID of Maximum Detected Concentration	Screening Value	Frequency of Exceedance[1]	Maximum Hazard Quotient	Arithmetic Mean	Mean Hazard Quotient	Base Background Value[3]	Retain?	Rationale?
Explosives (UG/L)												
1,3,5-Trinitrobenzene	0.52 - 0.52	0 / 2	--	--	NSV	-- / --	NSV	0.26	NSV	--	No	Not detected
1,3-Dinitrobenzene	0.52 - 0.52	0 / 2	--	--	NSV	-- / --	NSV	0.26	NSV	--	No	Not detected
2,4,6-Trinitrotoluene	0.52 - 0.52	0 / 2	--	--	NSV	-- / --	NSV	0.26	NSV	--	No	Not detected
2,4-Dinitrotoluene	0.52 - 0.52	0 / 2	--	--	NSV	-- / --	NSV	0.26	NSV	--	No	Not detected
2,6-Dinitrotoluene	0.52 - 0.52	0 / 2	--	--	NSV	-- / --	NSV	0.26	NSV	--	No	Not detected
2-Amino-4,6-dinitrotoluen	1.00 - 1.00	0 / 2	--	--	NSV	-- / --	NSV	0.50	NSV	--	No	Not detected
2-Nitrotoluene	0.52 - 0.52	0 / 2	--	--	NSV	-- / --	NSV	0.26	NSV	--	No	Not detected
3-Nitrotoluene	0.52 - 0.52	0 / 2	--	--	NSV	-- / --	NSV	0.26	NSV	--	No	Not detected
4-Amino-2,6-dinitrotoluen	0.52 - 0.52	0 / 2	--	--	NSV	-- / --	NSV	0.26	NSV	--	No	Not detected
4-Nitrotoluene	0.52 - 0.52	0 / 2	--	--	NSV	-- / --	NSV	0.26	NSV	--	No	Not detected
HMX	0.52 - 0.52	0 / 2	--	--	NSV	-- / --	NSV	0.26	NSV	--	No	Not detected
Nitrobenzene	0.52 - 0.52	0 / 2	--	--	270	-- / --	0.0019	0.26	9.63E-04	--	No	Not detected, HQ less than one
Nitroglycerin	0.65 - 0.65	0 / 2	--	--	NSV	-- / --	NSV	0.33	NSV	--	No	Not detected
Perchlorate	0.10 - 0.10	0 / 2	--	--	NSV	-- / --	NSV	0.050	NSV	--	No	Not detected
PETN	0.65 - 0.65	0 / 2	--	--	NSV	-- / --	NSV	0.33	NSV	--	No	Not detected
RDX	0.52 - 0.52	0 / 2	--	--	NSV	-- / --	NSV	0.26	NSV	--	No	Not detected
Tetryl	0.52 - 0.52	0 / 2	--	--	NSV	-- / --	NSV	0.26	NSV	--	No	Not detected
Inorganics (UG/L)												
Aluminum	-- - --	2 / 2	150	VL-GW02-12B	87.0	2 / 2	1.72	140	1.61	14000	No	Consistent with background
Antimony	0.50 - 0.50	0 / 2	--	--	160	-- / --	0.0031	0.25	0.0016	3.91	No	Not detected
Arsenic	0.50 - 0.50	1 / 2	0.26	VL-GW01-12B	150	0 / 2	0.0017	0.26	0.0017	9.79	No	Consistent with background
Barium	-- - --	2 / 2	43.0	VL-GW02-12B	NSV	-- / --	NSV	31.0	NSV	359	No	Consistent with background
Beryllium	0.40 - 0.40	1 / 2	0.12	VL-GW02-12B	0.53	0 / 2	0.23	0.16	0.30	0.874	No	Consistent with background
Cadmium	0.10 - 0.10	1 / 2	0.051	VL-GW01-12B	0.25	0 / 2	0.20	0.051	0.20	--	No	HQ less than one
Calcium [2]	-- - --	2 / 2	3,400	VL-GW01-12B	NSV	-- / --	NSV	2,850	NSV	179000	No	Consistent with background
Chromium (hexavalent)	10.0 - 10.0	0 / 2	--	--	NSV	-- / --	NSV	5.00	NSV	--	No	Not detected
Chromium	-- - --	2 / 2	0.47	VL-GW02-12B	74.0	0 / 2	0.0064	0.35	0.0047	16.9	No	Consistent with background
Cobalt	-- - --	2 / 2	1.30	VL-GW02-12B	NSV	-- / --	NSV	0.93	NSV	3.38	No	Consistent with background
Copper	-- - --	2 / 2	0.38	VL-GW02-12B	9.00	0 / 2	0.042	0.32	0.035	6.59	No	Consistent with background
Iron	-- - --	2 / 2	1,100	VL-GW02-12B	1,000	1 / 2	1.10	890	0.89	16100	No	Consistent with background
Lead	-- - --	2 / 2	0.19	VL-GW01-12B	2.50	0 / 2	0.076	0.18	0.072	8.92	No	Consistent with background
Magnesium [2]	-- - --	2 / 2	780	VL-GW01-12B	NSV	-- / --	NSV	695	NSV	13500	No	Macronutrient
Manganese	-- - --	2 / 2	42.0	VL-GW02-12B	NSV	-- / --	NSV	30.0	NSV	176	No	Consistent with background
Mercury	0.10 - 0.10	1 / 2	0.46	VL-GW02-12B	0.77	0 / 2	0.60	0.26	0.33	--	No	HQ less than one
Nickel	-- - --	2 / 2	2.60	VL-GW02-12B	52.0	0 / 2	0.050	1.80	0.035	11.8	No	HQ less than one
Potassium [2]	-- - --	2 / 2	1,300	VL-GW02-12B	NSV	-- / --	NSV	900	NSV	5590	No	Consistent with background
Selenium	1.00 - 1.00	1 / 2	0.63	VL-GW02-12B	5.00	0 / 2	0.13	0.57	0.11	--	No	HQ less than one
Silver	0.10 - 0.10	0 / 2	--	--	0.012	-- / --	8.33	0.050	4.17	0.724	No	Not detected
Sodium [2]	-- - --	2 / 2	9,300	VL-GW02-12B	NSV	-- / --	NSV	7,150	NSV	22700	No	Consistent with background
Thallium	0.10 - 0.10	0 / 2	--	--	4.00	-- / --	0.025	0.050	0.013	--	No	Not detected
Vanadium	-- - --	2 / 2	0.40	VL-GW01-12B	NSV	-- / --	NSV	0.37	NSV	26.7	No	Consistent with background
Zinc	-- - --	2 / 2	35.0	VL-GW02-12B	120	0 / 2	0.29	22.5	0.19	41.2	No	Consistent with background

TABLE G-6

Groundwater Screen

Site UXO-25 - Verona Loop PA/SI

MCIEAST-MCB CAMLEJ, North Carolina

Chemical	Range of Non-Detect Values	Frequency of Detection	Maximum Concentration Detected	Sample ID of Maximum Detected Concentration	Screening Value	Frequency of Exceedance[1]	Maximum Hazard Quotient	Arithmetic Mean	Mean Hazard Quotient	Base Background Value[3]	Retain?	Rationale?
Dissolved Metals (UG/L)												
Aluminum, Dissolved	50.0 - 50.0	1 / 2	31.0	VL-GW01-12B	87.0	0 / 2	0.36	28.0	0.32	14000	No	Consistent with background
Antimony, Dissolved	0.50 - 0.50	0 / 2	--	--	160	-- / --	0.0031	0.25	0.0016	3.91	No	Not detected
Arsenic, Dissolved	0.50 - 0.50	1 / 2	0.25	VL-GW02-12B	150	0 / 2	0.0017	0.25	0.0017	9.79	No	Consistent with background
Barium, Dissolved	-- - --	2 / 2	36.0	VL-GW02-12B	NSV	-- / --	NSV	28.0	NSV	359	No	Consistent with background
Beryllium, Dissolved	0.40 - 0.40	1 / 2	0.12	VL-GW02-12B	0.53	0 / 2	0.23	0.16	0.30	0.87	No	Consistent with background
Cadmium, Dissolved	0.10 - 0.10	0 / 2	--	--	0.25	-- / --	0.40	0.050	0.20	--	No	Not detected
Calcium, Dissolved[2]	-- - --	2 / 2	3,500	VL-GW01-12B	NSV	-- / --	NSV	2,750	NSV	179000	No	Consistent with background
Chromium, Dissolved	0.50 - 0.50	1 / 2	0.21	VL-GW01-12B	117	0 / 2	0.0018	0.23	0.0020	16.9	No	Consistent with background
Cobalt, Dissolved	-- - --	2 / 2	1.00	VL-GW02-12B	NSV	-- / --	NSV	0.80	NSV	3.38	No	Consistent with background
Copper, Dissolved	0.50 - 0.50	1 / 2	0.79	VL-GW02-12B	9.00	0 / 2	0.088	0.52	0.058	6.59	No	Consistent with background
Iron, Dissolved	-- - --	2 / 2	1,100	VL-GW02-12B	1,000	1 / 2	1.10	865	0.87	16100	No	Consistent with background
Lead, Dissolved	0.50 - 0.50	0 / 2	--	--	2.50	-- / --	0.20	0.25	0.10	8.92	No	Not detected
Magnesium, Dissolved[2]	-- - --	2 / 2	810	VL-GW01-12B	NSV	-- / --	NSV	700	NSV	13500	No	Consistent with background
Manganese, Dissolved	-- - --	2 / 2	33.0	VL-GW02-12B	NSV	-- / --	NSV	26.5	NSV	176	No	Consistent with background
Mercury, Dissolved	0.10 - 0.10	1 / 2	0.19	VL-GW02-12B	0.77	0 / 2	0.25	0.12	0.16	--	No	HQ less than one
Nickel, Dissolved	-- - --	2 / 2	2.10	VL-GW02-12B	52.0	0 / 2	0.040	1.53	0.029	11.8	No	Consistent with background
Potassium, Dissolved[2]	-- - --	2 / 2	1,300	VL-GW02-12B	NSV	-- / --	NSV	915	NSV	5590	No	Consistent with background
Selenium, Dissolved	-- - --	2 / 2	1.40	VL-GW02-12B	5.00	0 / 2	0.28	1.35	0.27	--	No	HQ less than one
Silver, Dissolved	0.10 - 0.10	0 / 2	--	--	0.012	-- / --	8.33	0.050	4.17	0.724	No	Not detected
Sodium, Dissolved[2]	-- - --	2 / 2	9,100	VL-GW02-12B	NSV	-- / --	NSV	7,100	NSV	22700	No	Consistent with background
Thallium, Dissolved	0.10 - 0.10	0 / 2	--	--	4.00	-- / --	0.025	0.050	0.013	--	No	Not detected
Vanadium, Dissolved	-- - --	2 / 2	0.38	VL-GW01-12B	NSV	-- / --	NSV	0.27	NSV	26.7	No	Consistent with background
Zinc, Dissolved	-- - --	2 / 2	22.0	VL-GW02-12B	120	0 / 2	0.18	17.0	0.14	41.2	No	Consistent with background

NOTES

NSV - No Screening Value

1 - Count of detected samples exceeding or equaling Screening Value

2 - Macronutrient - Not considered to be a COPC

3 - Background threshold value, surficial aquifer

HQ - Hazard Quotient

NSV - No Screening Value

UG/L - Micrograms per liter

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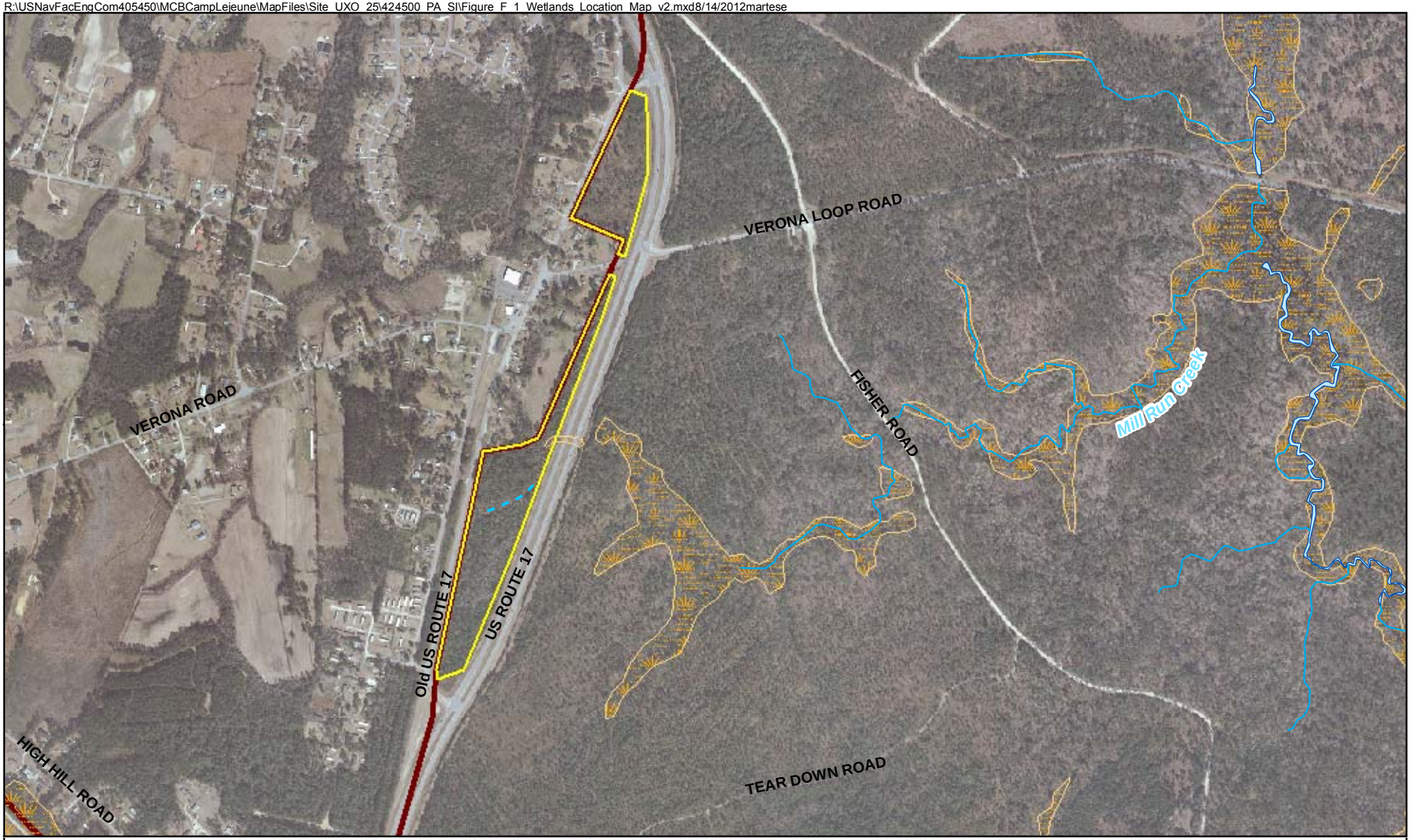

Legend

- Unnamed Drainage Ditch
- Surface Water Centerline
- Planning Wetland Area
- Surface Water Area
- UXO-25 - Verona Loop
- Installation Boundary

N

0 500 1,000 2,000 Feet

1 inch = 1,000 feet

Figure G-1
Wetlands Location Map
Site UXO-25 - Verona Loop PA/SI
MCIEAST-MCB CAMLEJ
North Carolina

CH2MHILL

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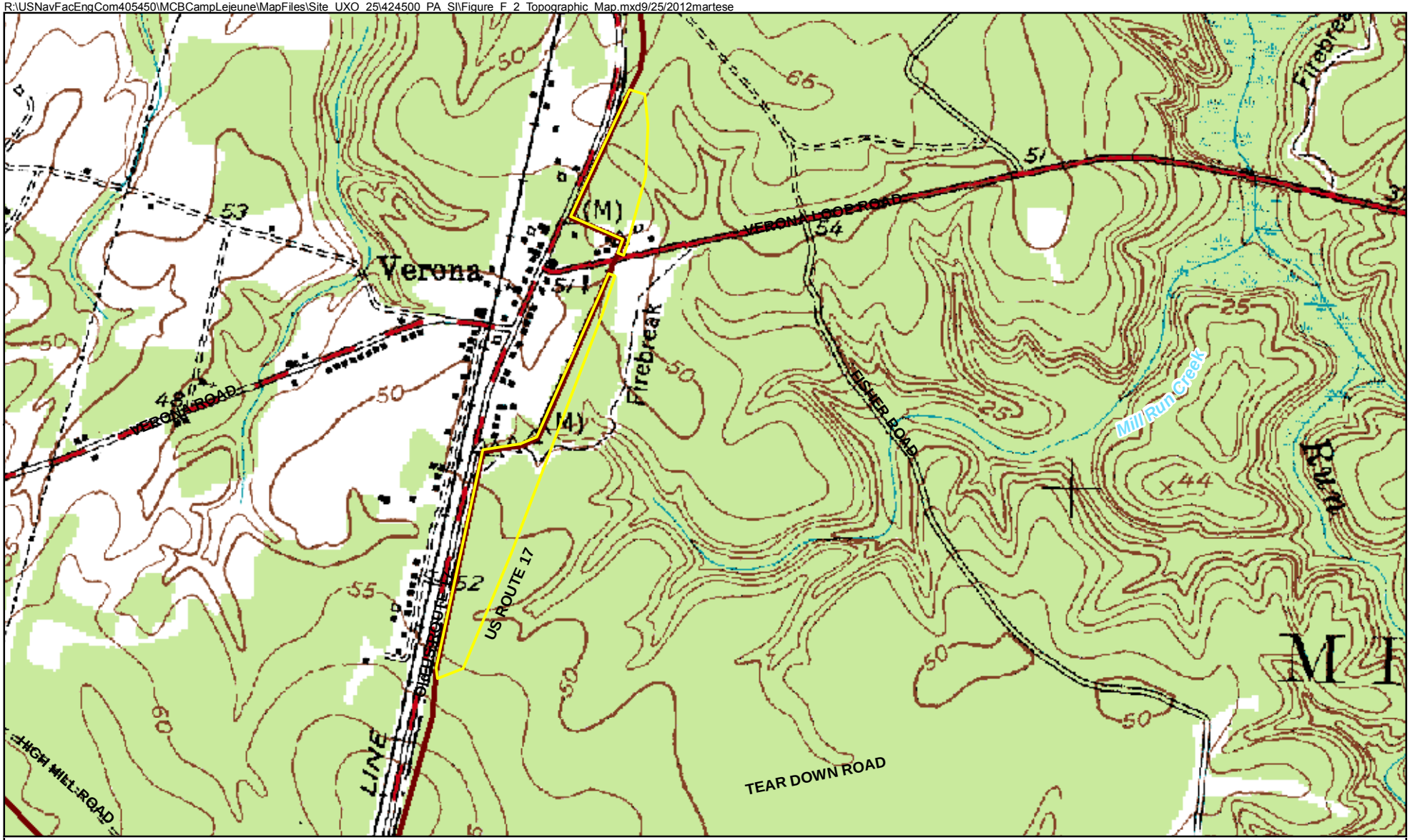

Legend

- UXO-25 - Verona Loop
- Installation Boundary

U.S. Geological Survey
Jacksonville South Quadrangle
North Carolina - Onslow Co.
Photoinspected 1988
1:24,000
7.5 Minute Series

N

0 500 1,000 2,000 Feet

1 inch = 1,000 feet

Figure G-2
Topographic Map
Site UXO-25 - Verona Loop PA/SI
MCIEAST-MCB CAMLEJ
North Carolina

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